

REPORT DOCUMENTATION PAGE				
1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE				
4. PERFORMING ORGANIZATION REPORT NUMBER(S) CRC 533 - Volume I			5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION Center for Naval Analyses		6b. OFFICE SYMBOL (If applicable) CNA		7a. NAME OF MONITORING ORGANIZATION Assistant Secretary of Defense Manpower, Installations, and Logistics, and U.S. Army Research Institute USARI
6c. ADDRESS (City, State, and ZIP Code) 4401 Ford Avenue Alexandria, Virginia 22302-0268		7b. ADDRESS (City, State, and ZIP Code) USARI The Pentagon Washington, DC 20301 5001 Eisenhower Ave. Alexandria, VA. 22333		
8a. NAME OF FUNDING / ORGANIZATION OASD / MI&L		8b. OFFICE SYMBOL (If applicable)		9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER N00014-83-C-0785
8c. ADDRESS (City, State, and ZIP Code) Department of Defense Washington, DC 20301		10. SOURCE OF FUNDING NUMBERS		
		PROGRAM ELEMENT NO. 65154N	PROJECT NO. R0148	TASK NO. WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) National Manpower Inventory Final Report, Volume I: Main Text				
12. PERSONAL AUTHOR(S) Aline Quester, Craig Goodwyn, Janice Olson, and Peter Perla				
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM Sep 1973 TO May 1985		14. DATE OF REPORT (Year, Month, Day) September 1985
15. PAGE COUNT 172				
16. SUPPLEMENTARY NOTATION				
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	Census, Civilian Personnel, Classification, Computer Programs, Data Bases, Data Files, DOT (Dictionary of Occupational Titles), Inventory, Inventory Modification Module, Inventory Reporting Module, Job Skills, Manpower, Military Personnel, Mobilization, NMI (National Manpower Inventory), Personnel Supply, Population, Software, Taxonomy	
05	09			
09	02			
19. ABSTRACT (Continue on reverse if necessary and identify by block number) This report on the National Manpower Inventory (NMI) is in three volumes. Volume I describes (1) the major inputs to the NMI and adjustments of the data made to meet NMI goals more directly; (2) the operational NMI model that was developed and its potential uses; and (3) some limitations inherent in the NMI data. Volume II provides technical documentation for the report, and Volume III is a user's guide to the software for the model.				
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL Dr. W.S. Sellman and Dr. Curtis L. Gilroy			22b. TELEPHONE (Include Area Code) (202) 695-5527 (703) 274-5610	22c. OFFICE SYMBOL OASD/MIL and USARI

NATIONAL MANPOWER INVENTORY FINAL REPORT,

Main Text.

Aline Quester
Craig Goodwyn
Janice Olson
Peter Perla

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED

A Division of

CNA

Hudson Institute

CENTER FOR NAVAL ANALYSES

4401 Ford Avenue • Post Office Box 16268 • Alexandria, Virginia 22302-0268 • (703) 824-2000

Work conducted under contract N00014-83-C-0725.

This Research Contribution represents the best opinion of CNA at the time of issue.
It does not necessarily represent the opinion of the Department of Defense.

CENTER FOR NAVAL ANALYSES

4401 Ford Avenue • Post Office Box 16268 • Alexandria, Virginia 22302-0268 • (703) 824-2000

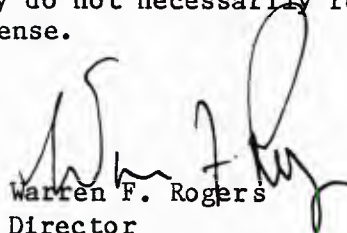
6 January 1986

MEMORANDUM FOR DISTRIBUTION LIST

Subj: Center for Naval Analyses Research Contribution 533,
Volumes I-III

Encl: (1) CRC 533, "National Manpower Inventory Final Report,"
Volumes I, II, and III, by Aline Quester, Craig Goodwyn,
Janice Olson, Peter Perla, September 1985

1. Enclosure (1) is forwarded as a matter of possible interest.
2. Research Contributions are distributed for their potential value in other studies and analyses. They do not necessarily represent the opinion of the Department of Defense.



Warren F. Rogers

Director

Naval Planning, Manpower, and Logistics
Division

Distribution List:
Reverse page

Subj: Center for Naval Analyses Research Contribution 533

Distribution List

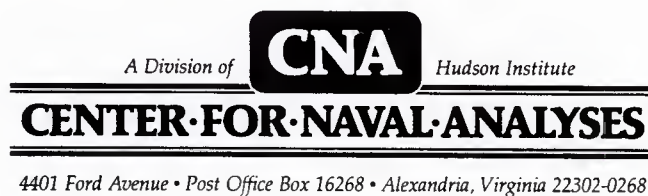
Assistant Secretary of Defense (Manpower, Installations and Logistics)
Director, Accession Policy (OSD/FMP) (Attn: Dr. W.S. Sellman) (20 copies)
Army Research Institute (3 copies)
Navy Personnel Research and Development Center (3 copies)
Air Force Human Resources Laboratory (3 copies)
Defense Manpower Data Center
Assistant Secretary of Defense (Reserve Affairs)
Assistant Secretary of the Navy (Manpower and Reserve Affairs)
Assistant Secretary of the Army (Manpower and Reserve Affairs)
Assistant Secretary of the Air Force (Manpower, Reserve Affairs and Installations)
Office of Naval Research
Office of Naval Reserve (OCNO, OP-09R)
Office of Naval History (OCNO, OP-09BH)
Program Resource Appraisal Division (ONCO, OP-91)
Deputy Chief of Staff, Reserve Affairs, HqMC
U.S. Naval Academy
U.S. Naval Postgraduate School
U.S. Naval War College
National Defense University
Defense Advanced Research Projects Agency
Department of the Army Library
U.S. Military Academy (Office of Economic and Manpower Analysis)
National Science Foundation
Institute for Defense Analyses
The Rand Corporation, Project Air Force
Defense Technical Information Center (12 copies)

NATIONAL MANPOWER INVENTORY FINAL REPORT

Main Text

Aline Quester
Craig Goodwyn
Janice Olson
Peter Perla

Naval Planning, Manpower, and Logistics Division



ABSTRACT

This report on the National Manpower Inventory (NMI) is in three volumes. Volume I describes (1) the major inputs to the NMI and adjustments of the data made to meet NMI goals more directly; (2) the operational NMI model that was developed and its potential uses; and (3) some limitations inherent in the NMI data. Volume II provides technical documentation for the report, and volume III is a user's guide to the software for the model.

EXECUTIVE SUMMARY

This report describes and documents the databases and associated software completed for the National Manpower Inventory (NMI) program. The purpose of the NMI is to determine the supply of civilians with skills relevant to the military so as to enhance the military's recruiting and retention efforts and to aid in mobilization planning. Such an inventory was mandated by the 97th Congress.

The largely empirical work described in this report builds on previous NMI efforts. In particular, based on conceptual investigations of skills and their transferability, occupations are used as the operational definitions of skills. In addition, previously established matches between occupational specialties in the military and occupations in the civilian economy were basic inputs for this NMI product.

The text is divided into three volumes and is accompanied by computer software and data tapes. The development of the operational NMI system is described in volume I. The basis for the NMI civilian count is the 1980 U.S. Census. Counts, by occupation, were restricted to persons not reporting disabilities in 1980 and were further adjusted by statistically removing members of the Selected Reserve. In addition to veteran status, demographic characteristics of occupational incumbents are retained on the files.

To identify which civilian occupations involve militarily relevant skills, two on-line data systems cross referencing occupational codes from different occupational taxonomies were used. The first, developed by analysts at the Office of the Assistant Secretary of Defense (Manpower, Installations, and Logistics) (OASD/MI&L), matches military jobs (by MOS and rank) to civilian ones using the Department of Labor's *Dictionary of Occupational Titles* (DOT). Of the 5,535 military titles on that crosswalk, 67 percent had civilian counterparts in the DOT taxonomy.

The second, developed by the National Occupational Information Coordinating Committee (NOICC), cross classifies DOT titles with other civilian occupational taxonomies. In particular, the NOICC crosswalk provides a link between DOT title and the classification system used in the 1980 Census. Since there are no current counts of the numbers of civilian workers according to the DOT classification system, this linkage is critical for the inventory. With the linkage of the two crosswalks, 53 percent of the 472

DOT-matched Census titles in the 1980 Census occupational classification were identified as having militarily relevant incumbents.

After describing the major inputs and adjustments of occupational counts and titles, two enhancements to the database are discussed. First, strategies for updating the 1980 civilian counts and the calculation of update factors for the NMI data files are described. Because of limitations in data available for updates and because the need for current counts of skilled civilians will continue, the computer software has been designed to easily accommodate changes in the actual factors used for updating the inventory.

The second enhancement takes account of another key supply source for mobilization: persons in civilian training programs. Data sources on education and training make possible counts of such persons by field of instruction. The potential use of counts from instructional coding systems are illustrated graphically, revealing the considerable geographic detail available in these data sources.

The heart of this final report is the description of the NMI model and how it works. Because many different questions will be asked of the NMI system, the computer software for accessing and presenting the inventory is flexible. Ways in which the NMI inventory modification module can be used to restrict or update the civilian input data are described, and an example is provided.

The NMI reporting module makes options available to users for disaggregating inventory counts and displaying printed output. Samples of NMI output using actual inventory counts for specific MOSs and graphic displays of skilled civilian distributions among the states accompany the discussion of these options.

Because of the way military forces are usually developed, many users of the inventory will wish to estimate the potential number of "units" (e.g., full Army divisions) that can be mobilized for various emergency or war scenarios. Thus, the problem of "bottlenecks" in mobilization is addressed, and illustrations of how civilians with skills relevant to many military occupational specialties can be allocated most efficiently among specific MOSs are provided. Illustrations of efficient allocations of civilians using hypothetical bottleneck situations accompany the discussion, as does the mathematical solution to the bottleneck problem, which has been programmed into the NMI software. An example of the NMI allocation module and sample output show how the software works.

The four appendixes in volume II focus on the major empirical problem resulting from sources available for input to the NMI—namely, the lack of precision in the counts of civilians with militarily relevant occupational skills. The fundamental methodological problem is caused by the need to rely on matches across several civilian occupational classification systems that differ significantly in occupational detail. After a general discussion, the problem is formulated statistically. An alternative methodology—using an April 1971 Current Population Survey database that was coded into both DOT and Census codes—is described, but found to have major shortcomings. These shortcomings led to the decision not to use these data to weight 1980 Census occupational counts. Finally, based on empirical work with the NMI, ways in which civilian/military linkages might be further explored to allow a more precise inventory of skilled civilians for mobilization supply analysis are suggested.

Volume III of this report is designed primarily for programmers and analysts who will use the software necessary to run the NMI. This volume contains the data dictionary and documentation for the ten data files, their associated parameter files, and the programs that provide access to the data files and build the inventory. A special file of incumbent counts by MOS (active duty, selected reservists, and recent veterans) is also documented in this volume. (The software and data files are provided on computer tape.) The appendixes to volume III present detailed occupational and geographic codes and source listings for the main computer programs.

TABLE OF CONTENTS

	<u>Page</u>
VOLUME I	
List of Illustrations	xi
List of Tables	xv
Introduction	1
The 1980 Census Database	4
Selected Reservists	4
Veterans	9
Census Information on Veteran Status	10
DMDC Administrative Record Data on Veteran Status	11
Treatment of Recent Veterans	11
Segmenting the Population: Summary	11
Linking Civilian Occupations to Military Occupations:	
The Crosswalks	13
The OASD/MI&L Crosswalk	13
The NOICC Crosswalk	14
The OASD/MI&L-NOICC Crosswalk	16
CNA-Constructed Occupational Dictionary Files	17
Updating the 1980 Census Information: Some Options and an	
Empirical Strategy	20
1980 Data	20
1983 Data	21
Occupational Employment Service Databases	22
Alternative Databases.....	24
Data on Civilian Training Pipelines	26
Training Data Sources	27
Students in Vocational Training.....	28
Students in Institutions of Higher Education	29
Counting Vocational Training Students by Their Military	
Job Classification	29

TABLE OF CONTENTS (Continued)

	<u>Page</u>
The CNA National Manpower Inventory Model	39
Inventory Modification Module	39
Example of Software for Inventory Modification Module	41
Reporting Module	43
Example of Software for Reporting Module	43
Output From the Reporting Module	45
Count of Civilians	46
The Question of Mobilization Skill Shortages	74
An Example of the Allocation Problem	75
Solution to the Bottleneck Problem	79
The Allocation Module in the NMI Model	81
Example of Software for the Allocation Model	81
Summary	91
References	92
Appendix A: Samples of the CNA-Constructed Crosswalk Dictionary	A-1 – A-3
Appendix B: Census Occupations and Their Crosswalk to Military Occupations	B-1 – B-16
Appendix C: Examples of Output From CNA National Manpower Inventory Model	C-1 – C-24
Appendix D: Examples of the Computer-Generated Allocation Module Report	D-1 – D-6

VOLUME II

Appendix A: Technical Difficulties With the MOS/Census Occupation Matches	A-1 – A-9
--	-----------

TABLE OF CONTENTS (Continued)

	<u>Page</u>
Appendix B: A Statistical Discussion of the Overcount Problem	B-1 – B-3
Appendix C: An Earlier Attempt To Count	
DOT Incumbants	C-1 – C-3
References	C-4
Appendix D: Technical Lessons From the NMI	D-1 – D-13
References	D-14
Appendix E: Examples of Instructional Codes Used by the National Center for Education Statistics	E-1 – E-6

VOLUME III

Introduction.....	1
Data Dictionary	1
Data File Descriptions.....	3
Data Files.....	5
Census Tabulations	5
File 1: Basic Census Tabulations	5
Reserve Probabilities.....	6
Files 2 and 3: Reserve Probabilities for 1980 and 1983	6
Update Data	6
File 4: Occupational Update Data for 1983	6
Crosswalk.....	7
File 5: OASD/MI&L Crosswalk.....	7
Crosswalk-Compatible Counts	8
Files 6 and 7: Crosswalk-Compatible Counts of Active-Duty Military Personnel, 1980-1984.....	8
Mini Data Files.....	8
Files 8 Through 10: Mini Data Files	8

TABLE OF CONTENTS (Continued)

	<u>Page</u>
Parameter Files.....	9
Files 11 Through 16: Parameter Files Associated With Data Files 1 Through 10	9
Computer Programs.....	10
Inventory Modification	11
File 17: Inventory Modification Module	11
Inventory Reporting.....	12
File 18: Inventory Reporting Module.....	12
Bottlenecks.....	13
File 19: Allocation Module.....	13
Counts of Military Personnel.....	15
File 20: Counts of Active-Duty, Selected Reservists, and Recent Veterans by Military Job	15
Appendix A: Census Industry Codes	A-1 – A-8
Appendix B: Census Occupation Codes	B-1 – B-8
Appendix C: Department of Defense Occupation Codes	C-1 – C-7
Appendix D: FIPS State Codes	D-1
Appendix E: Military Occupational Specialty Codes	E-1 – E-40
Appendix F: Source Listing of Main Computer Program for Inventory Modification Module	F-1 – F-8
Appendix G: Source Listing of Main Computer Program for Reporting Module	G-1 – G-9
Appendix H: Source Listing of Main Computer Program for Allocation Module	H-1 – H-15

LIST OF ILLUSTRATIONS

		<u>Page</u>
1	Illustration of Crosswalk Results	16
2	The Crosswalk Between 1980 Census Occupational Codes and the 1979-1981 OES Occupational Taxonomy	23
3	Electronic Equipment Repairman (DOD OCC Code 1)	34
4	Communications Center Operations (DOD OCC Code 26)	35
5	Medical Care Specialist (DOD OCC Code 30)	36
6	Electrical/Mechanical Equipment Repairman (DOD OCC Code 6)	37
7	Aircraft Electrical/Mechanical Equipment Repairman (DOD OCC Code 60)	38
8	The NMI Model	40
9	Audio-Visual Equipment Repairer (Army, Enlisted, Service OCC Code 41E)	49
10	Aircraft Electrician (Army, Enlisted, Service OCC Code 68F)	50
11	Legal Clerk (Army, Enlisted, Service OCC Code 71D)	51
12	Flight Operators Coordinator (Army, Enlisted, Service OCC Code 71P)	52
13	Air Traffic Control Tower Operator (Army, Enlisted, Service OCC Code 93H)	53
14	Data Processing Systems Repair Technician (Army, Warrant Officer, Service OCC Code 278A)	54

LIST OF ILLUSTRATIONS (Continued)

		<u>Page</u>
15	General Medicine Officer (Army, Commissioned Officer, Service OCC Code 60E)	55
16	Sanitary Engineer (Army, Commissioned Officer, Service OCC Code 68P)	56
17	Equipment Operator, Chief (Navy, Enlisted, Service OCC Code EO)	57
18	Hospital Corpsman, Third to First Class (Navy, Enlisted, Service OCC Code HM)	58
19	Radioman, Chief or Master Chief (Navy, Enlisted, Service OCC Code RM)	59
20	Storekeeper, First Class to Chief (Navy, Enlisted, Service OCC Code SK)	60
21	Test Pilot (Navy, Officer, Service OCC Code 8588)	61
22	Air Traffic Control Radar Specialist (Air Force, Enlisted, Service OCC Code 30351)	62
23	General Purpose Vehicle Mechanic (Air Force, Enlisted, Service OCC Code 47252)	63
24	Computer Programmer Specialist (Air Force, Enlisted, Service OCC Code 51151)	64
25	Vehicle Operator/Dispatcher (Air Force, Enlisted, Service OCC Code 60350)	65
26	Navigator, General (Air Force, Officer, Service OCC Code 1535)	66

LIST OF ILLUSTRATIONS (Continued)

		<u>Page</u>
27	Civil Engineering Officer (Air Force, Officer, Service OCC Code 5525)	67
28	Supply Operations Officer (Air Force, Officer, Service OCC Code 6424)	68
29	Office Machine Repair Specialist (Marine Corps, Enlisted, Service OCC Code 1182)	69
30	Radio Technician (Marine Corps, Enlisted, Service OCC Code 2861)	70
31	Military Police Officer I (Marine Corps, Officer, Service OCC Code 5803)	71
32	Aeronautical Engineer (Marine Corps, Officer, Service OCC Code 6005)	72
33	Hypothetical Allocation Problem	76
34	Inefficient Solution to Hypothetical Allocation Problem	77
35	Efficient Solution to Hypothetical Allocation Problem	78
36	Hypothetical Example of a Bottleneck	78
37	The NMI Model With Bottleneck Report	82

LIST OF TABLES

		<u>Page</u>
1	Descriptive Statistics from 1980 Decennial Census	5
2	Descriptive Statistics for Selected (Drilling) Reservists	7
3	Breakdown of Missing Data for Selected Reservists	8
4	Occupational Counts from the Crosswalks	15
5	Summary Description of HEGIS and VEDS Survey Designs	27
6	Civilian Training Program Completions by DoD Enlisted Occupational Codes	31
7	Inventory Counts for Selected Military Occupational Specialties, in Thousands	47
8	Civilian Matches to an Army Enlisted Occupation, Metalworker: An Illustration of How the Civilian Inventory Might Be Organized	73
9	Mobilization Supply: DoD Occupations by Civilian Counts for Ratio of Civilians to 1980 Active Duty E-4s and E-5s	87
10	Mobilization Supply: DoD Occupations by Civilian Counts for Ratio of Civilians to 1980 Active Duty E-3s and E-9s	89

INTRODUCTION

With the introduction of the All-Volunteer Force (AVF) in 1973, new challenges faced those responsible for the recruitment and retention of military personnel. When the AVF was introduced, children of the peak fertility year of America's "baby boom" were 16 years old. Since then, the American age structure has changed considerably, in ways likely to have an impact on recruitment and retention in the years ahead.

From 1970 to 1980, the U.S. population grew 11 percent, but it was an uneven growth. The group of baby boomers aged 25 to 29 increased 44 percent, the 20 to 24 group was up 25 percent, and there were 11 percent more young people aged 15 to 19. However, by 1980 the number of persons under 14 had declined by 12 percent to 33 million — 4 million fewer than were in that age group in 1970. Thus, unless the number of young immigrants increases dramatically in the coming years, the population reaching young adulthood will be considerably smaller than any the AVF has yet experienced.

This diminution of the military's major labor supply pool increased the need to look ahead and examine ways in which the military might substitute a greater mix of policies for one relying substantially on the younger adult population. As part of this examination, Congress directed the Secretary of Defense in H.R. 6974 (U.S. Congress, House, 1980) and Senate Bill S. 2248 to determine the level of skilled labor in the civilian sector that could (1) enhance the ongoing recruiting and retention efforts of the Department of Defense and (2) better estimate available manpower and skills for mobilization planning purposes.

In response, the National Manpower Inventory (NMI) project was created as a Tri-Service/Department of Defense cooperative research effort, with the U.S. Army designated as the lead agency. The purpose of the NMI was to identify military skills in the civilian population, to inventory those skills, and to project the future inventory. To oversee the research, an NMI Working Group was established, with Dr. Curtis L. Gilroy, U.S. Army Research Institute, as Chairman. Other members included Dr. W. S. Sellman, Office of the Assistant Secretary of Defense (Manpower, Installations and Logistics) (OASD/MI&L); Dr. Jules Borack, U.S. Navy Personnel Research and Development Center; Mr. Larry Looper, U.S. Air Force Human Resources Laboratory; and Dr. Zahava Doering, Department of Defense Manpower Data Center (DMDC). Dr. Anita Lancaster (OASD/MI&L), Dr. David Boesel (DMDC), and Dr. Kyle Johnson (DMDC) provided support to the Working Group.

The NMI has also involved the participation of many nondefense agencies, including the Department of Labor, the Bureau of the Census, and the Department of Education. From the NMI Working Group, the Departments, and NMI contractors have come some important conceptual investigations of skills, their measurement, relationships between skills and occupations, and the transferability of skills among occupations. From these examinations, which included review of civilian and military data available to the NMI, a number of conceptual and technical issues – critical to the development of an NMI system – were resolved.

First, the question of “how to define and measure *skill*” was addressed. After extensive discussion of this issue, a working definition of skill was developed by Silva (1983:19): “The definition of skill as a vocational specialty or occupation appears to be the most consistent with the best available current skill data which are applicable to both military and civilian sectors.” Although the Silva report presents this as an interim definition and notes the limitations of using occupation as a proxy for skill, the NMI Working Group also concluded, albeit somewhat reluctantly, that there is no viable alternative for a project with the empirical scope of the NMI.

Second, the question of “what civilian occupational classification system best meets the needs of the NMI” was addressed. Numerous civilian taxonomies were reviewed with particular focus on their strengths and weaknesses in meeting NMI requirements for maximum occupational detail and information on the characteristics of skilled civilian personnel. In particular, the age distribution of occupational incumbents is important since persons over age 35 traditionally have not been recruited – even in World War II. Similarly, the sex of civilians with militarily relevant skills is important since combat positions are restricted to men. In addition, because recruitment goals are often tied to detailed areas, geographic locations of incumbents are important. Information on other characteristics of civilian personnel (e.g., education, race, veteran status) were deemed desirable, if less critical, enhancements to the database. Reviews of these requirements led to the decision to use the 1980 Census of Population as the primary source of civilian occupational information.

Next, the important question of linkages between civilian occupations and military specialties was investigated. It had long been recognized that there was no perfect correspondence between job/occupational definitions in military and civilian sectors, but researchers had also long worked for comparability – among the services, among the civilian classification systems, and between civilian and military systems. Concurrent with the NMI Working Group meetings, two other intensive projects were addressing precisely these issues. The first, an OASD/MI&L project focusing on the issue

of civilian-military comparability, had resulted in a match or "crosswalk" between military specialties and a civilian job or jobs at the *Dictionary of Occupational Titles* (DOT) level. The second project, conducted by the National Occupational Information Coordinating Committee (NOICC) focused on linking the DOT taxonomy to 1980 Census classifications. (The DOT system describes the kinds of jobs being done in the American economy, whereas the Census describes the people who do those jobs.) With the roughly simultaneous completion of these two independent projects, the potential for a detailed count of civilians with specific skills relevant to the military was immediately recognized.

A final key question for the NMI Working group was "how to measure skills of students." The traditional source of military personnel is young people aged 17 to 21. Because they are often in entry-level civilian jobs or not yet firmly established in the labor force, young people in educational or vocational training programs were also identified as an important focus of the NMI. Although 1980 Census data identify students, they do not identify the field of training or study being pursued. For information on those characteristics, it was decided to explore the resources of the Department of Education.

The Working Group recognized that, in addition to the need for a strategy for addressing these technical issues, an operational NMI model with flexibility of two sorts was needed. First, an NMI model allowing for refinements and updates was specified, so that the system could respond to changes in the occupational structure and the supply of skilled civilians, as well as in the educational and occupational taxonomies used to describe them. Second, a system responsive to varying military needs was essential, since no single set of "critical skills" could meet every recruitment goal or mobilization scenario (McFann-Gray and Associates, 1984).

This final report on the NMI is in three volumes. This first volume describes in detail the major inputs to the NMI, emphasizing how data were adjusted to meet NMI goals more directly. It then focuses on the operational model developed from the inputs in the context of the potential uses the data. Finally, a pragmatic discussion of the limitations of the data is offered to aid succeeding NMI analysts and users in identifying and disentangling some of the skill-occupational complexities encountered in this effort. Volume II of this report provides technical appendixes, and volume III provides a guide to the software for the NMI model.

THE 1980 CENSUS DATABASE

The major data on civilians are from the Five-Percent Public Use Master File (PUMS) of the 1980 Census. The first step was to extract the records of all individuals 16 years of age or older. Next, since the Decennial Census enumerates both civilians and active military personnel, the latter were removed from the Census inventory. Coincidentally, individuals who reported they had a disability (which limited their ability to work, the kind of work performed, or their ability to utilize public transportation) were removed. After restricting the population to nondisabled civilians over the age of 16 years, the Census data extract contained 7,306,131 individuals.¹

For each remaining individual in the database, information on sex, race, age, education, state of residence, labor force status, class of work, occupation, and industry remain on the extract file. Table 1 provides some descriptive statistics for these Census data.

In addition to the active military personnel, two other groups in the database should be distinguished from the overall population: reservists and recent veterans. Treatment of these groups is discussed below.

SELECTED RESERVISTS

The United States has several categories of reservists. Broad categories are the Ready Reserve (composed of the Selected Reserve and the Individual Ready Reserve), the Standby Reserve (with Active and Inactive statuses), and the Retired Reserve. For both readiness and mobilization, the Selected Reserve (SELRES) is the most important. SELRES personnel drill for one weekend a month and attend a two-week active duty summer training program. Although there are differences across services (for example, Navy SELRES personnel primarily bring ships from peacetime to wartime requirement levels whereas Air Force SELRES primarily mobilize as

1. Those removed from the census database included 81,859 individuals because they were in the active military and 1,154,393 individuals because of a disability. Since this is a 5-percent random sample, population estimates can be obtained by multiplying the counts by a factor of 20.

independent units), each service has specified tasks designated for their Selected Reserves.

TABLE 1
DESCRIPTIVE STATISTICS FROM 1980 DECENNIAL CENSUS^a

<u>Variable</u>	<u>Number of observations</u>	<u>Percentage distribution</u>
Sex		
Male	3,457,857	47.3
Female	3,848,274	52.7
Education (completed)		
Not high school graduate	2,303,860	31.5
High school graduate	3,139,033	43.0
Two years college	778,054	10.6
Four years college	772,234	10.6
Six years college	211,823	2.9
Eight years college	101,127	1.4
Race		
White	6,223,276	85.2
Black	748,380	10.2
Other	334,475	4.6
Labor Force Status		
Employed (1979 or survey week 1980)	5,510,223	75.4
Worked since 1975 ^b	381,743	5.2
Not in labor force	1,414,165	19.4
Veteran status		
Veteran	1,200,910	16.4
Since May 1975	71,908	1.0
Before May 1975	1,129,002	15.4
Not a veteran	6,105,221	83.6

TABLE 1 (Continued)

<u>Variable</u>	<u>Number of observations</u>	<u>Percentage distribution</u>
Age (single years available)		
16-19	813,625	11.1
20-24	983,080	13.4
25-29	912,068	12.5
30-34	822,305	11.3
35-39	645,677	8.8
40-44	530,571	7.3
45-49	490,307	6.7
50-54	497,939	6.8
55-59	464,977	6.4
60-64	375,234	5.1
65 +	770,348	10.5
State of residence ^c		
Occupation ^c		
Industry ^c		
Class of worker ^c		

a. The source is the 1980 Census PUMS (Five-Percent Sample); our extract is for nondisabled individuals 16 years of age and over who are not in the active military.

b. These are individuals who have an occupation but did not work in 1979 or in the Census survey week in 1980.

c. Not tabulated, but specific data are available for all individuals in the sample.

Since the military value of drilling SELRES reservists is in their military occupational specialty (MOS) rather than in their civilian job skill, the inventory of SELRES personnel should be by their MOS. Thus, the second step necessary to refine the Census enumeration is to separate out SELRES personnel. Unfortunately, the 1980 Census contains no information on reserve status. However, the data do allow statistical distributions of the characteristics of SELRES personnel to be constructed; with these distributions it is possible to "statistically remove" reservists. Before discussing how this was done, however, it is worthwhile to examine the characteristics of the nation's Selected Reserves.

Table 2 details the characteristics of SELRES personnel—officer and enlisted—in 1980, the year of the Census. In September 1980, there were

TABLE 2
DESCRIPTIVE STATISTICS FOR SELECTED (DRILLING) RESERVISTS
(N = 849,057)

<u>Variable</u>	<u>Number of observations</u>	<u>Percentage distribution</u>
Sex		
Male	781,106	92.0
Female	67,868	8.0
Unknown	83	.0
Education ^a		
Not high school graduate	163,463	19.3
High school graduate	477,991	56.3
Two years college	75,357	8.9
Four years college	93,748	11.0
M.A./M.S.	25,880	3.1
Ph.D./M.D./etc.	8,659	1.0
Unknown	3,959	.4
Race ^b		
White	676,215	79.6
Black	138,892	16.4
Other	27,001	3.2
Unknown	4,949	.6
Age ^c		
16-19	73,292	8.6
20-24	191,578	22.6
25-29	144,932	17.1
30-34	172,599	20.3
35-39	110,436	13.0
40-44	67,906	8.0
45-49	46,957	5.5
50-54	25,081	3.0
55 +	10,950	1.3
Unknown	5,326	.6
Veteran status		
Veteran	354,623	41.8
Not veteran	494,434	58.2
State of residence ^d		
Known	848,593	100.0
Unknown	464	.0

a. Individuals are placed in the highest completed category.

b. Reserve records provide codes for Asian/Mongoloids and American Indian/Eskimo/Aleutians, but there are no entries for these codes in the race field.

c. Single years of age are available.

d. State of residence is available.

849,057 drilling reservists; over 80 percent of them were under 40 years of age. (The SELRES data come from the Defense Manpower Data Center (DMDC) Master File, and the data are very complete. As is indicated in table 3, only 1 percent of the records are missing any of the information that will be used in this analysis.)¹

TABLE 3
BREAKDOWN OF MISSING DATA FOR SELECTED RESERVISTS

<u>Number of fields missing per reservist</u>	<u>Number of observations</u>	<u>Frequency</u>
0	840,531	99.0
1	4,586	0.5
2	1,687	0.2
3	2,191	0.3
4	62	0.0
5 or more	0	-

With the information on sex, education, race, age, veteran status, and state of residence of reservists, a matrix of reserve characteristics was created. This matrix has 40,392 cells, and each cell represents a count of a particular group defined by the following criteria²:

Sex Education Race Age Veteran State
(2) × (6) × (3) × (11) × (2) × (51) = 40,392 cells

With these counts of reservists, the Census extract file was statistically adjusted, effectively removing SELRES personnel from the civilian inventory.

1. Missing values are allocated in proportion to corresponding totals from similar records. For example, if there are 10 missing values for sex, and observations with similar residence, education, race, age, and veteran status are 80 percent male and 20 percent female, the sum of male observations with these characteristics is incremented 8 and the sum of female observations with these characteristics is incremented 2.

2. The categories are those found in table 2 (except that the 55+ age group was further broken into 55-59, 60-64, and 65+).

U.S. NONDISABLED CIVILIAN POPULATION
(16 years and over)

Not in SELRES	SELRES
---------------	--------

For example, if there are 100 reservists and 10,000 individuals in the civilian population who are 16 to 19 years old, high school dropouts, white, male, veterans, and living in Alabama, the reservists are statistically removed from the civilian population by counting only 99.9 percent (9,900/10,000) of civilians with these characteristics.¹

The resulting extract provides an inventory of "true civilians"—individuals who are neither in the active military nor in the nation's drilling reserves. However, the extract contains many individuals who are veterans of military service,² and information on the military skills of some veterans is available from other sources.

VETERANS

The remaining civilian population is composed of individuals who have had active-duty military experience and those who have not. Individuals who have served in the military—particularly those who have served recently—have both military MOSs and civilian jobs. It is worthwhile to detail what information is available on recent veterans' military and civilian occupations. First, both self-reported veteran status and civilian occupation are available from 1980 Census files. In addition, administrative record data containing the individual's military specialty were provided by DMDC.

1. It should be noted that this procedure assumes reservists and nonreservists, given similar characteristics of age, sex, race, education, and geographic location, have similar civilian occupational distributions. Some attempts were made to check the validity of this assumption by examining the civilian occupation field of Navy and Air Force reserve personnel files (the DMDC reserve data file does not have a field for civilian occupations). Unfortunately, the fill rate for the civilian occupation field was low. Because the available information may be non-random, further validation attempts did not appear to be worthwhile.

2. Veterans in the Selected Reserve have been statistically removed from the data set.

Census Information on Veteran Status

The relevant 1980 Census questions are as follows:

- 18a. Is this person a veteran of active-duty military service in the Armed Forces of the United States?
 - o Yes
 - o No – Skip to 19
- b. Was active-duty military service during (fill circle for each period in which this person served):
 - o May 1975 or later
 - o Vietnam era (August 1964 – April 1975)
 - o February 1955 – July 1964
 - o Korean conflict (June 1950 – January 1955)
 - o World War II (September 1940 – July 1947)
 - o World War I (April 1917 – November 1918)
 - o Any other time

Since the Census does not ask if individuals completed their enlistment term (or if they were eligible to reenlist when they left the active military), it is quite possible that attriters and ineligible are identified as veterans by the Census.¹ In short, the Census records show reported veteran (or recent veteran) status as well as civilian occupation, residence, and other demographic information.

1. Many members of the active military identify themselves as veterans in Census and other household surveys. Since the Census data extract has been restricted to civilians, these cases will not be counted twice.

DMDC Administrative Record Data on Veteran Status

Information on the military specialties and reenlistment eligibility status of veterans can be obtained from military administrative record data. Recent veterans, essentially individuals who would have answered the Census veteran status query as "May 1975 or later," make up the group for whom military specialties would be most relevant.

For this information, the DMDC Prior Service Military Availability (PSMA) files have been utilized. These files contain 6 years of data for individuals who (1) left the military with good reenlistment eligibility codes and (2) did not subsequently reenlist or join SELRES. Tabulations from the files contain data for 1977 to 1982. These tabulations, for each MOS, are by age, sex, year left military, and Census region.

Treatment of Recent Veterans

Since data that integrate individual MOS/civilian occupation are not available, it is not possible to compare a veteran's military and civilian occupations. For measuring militarily relevant skills in the civilian population, however, there are at least two possible ways to treat recent veterans: (1) ignore veteran status (inventory the skills of veterans using their civilian occupations); or (2) inventory the skills of recent veterans by military MOSs (using DMDC administrative record data for those eligible to reenlist). Under the second option, all individuals who indicated that they were released from active duty after May 1975 will be removed from the civilian labor pool; only the skills of the remaining not-recent-veteran civilians will be identified by their Census-defined civilian occupation.

Most users will want to inventory skills using the second option, although others might prefer the capability of capturing advancements of recent veterans to more highly skilled civilian work in militarily relevant fields. Therefore, the decision was made to retain all relevant information and allow users to select either option.

SEGMENTING THE POPULATION: SUMMARY

First, using the 1980 Census, individuals in the active military and individuals who identified themselves as disabled were extracted. This was straightforward, because Census data directly identify both groups. Next,

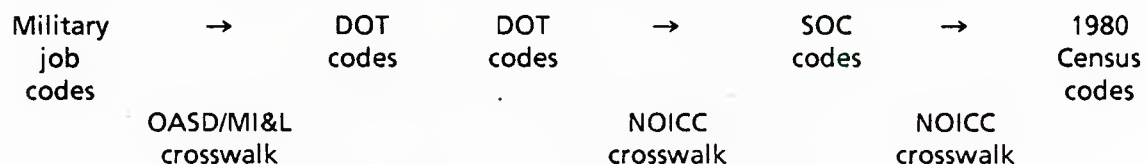
because members of the Selected Reserve were not identified in the 1980 Census, distributions of reservists' characteristics were constructed, and these distributions were used to reduce the population accordingly. Both the active military and drilling reservists have designated military specialties; these individuals should be inventoried on the basis of their military jobs.

The remaining population is composed of veterans and nonveterans. Identifiers for both the veterans and the recent veterans are available, but both groups have been kept in the population. As noted above, it will be useful to maintain the ability to calculate the inventory both with and without veterans. In fact, as detailed below, the model allows the user to specify the characteristics of those to be inventoried: their age, sex, veteran status, and so on. Before turning to a discussion of the model, however, procedures for identifying military skills in the civilian population are discussed.

LINKING CIVILIAN OCCUPATIONS TO MILITARY OCCUPATIONS: THE CROSSWALKS

A database identifying civilians with skills transferable to particular military occupational specialties is the core of the NMI. As noted, such a database needed to (a) identify all military occupations that have civilian counterparts; (b) specifically match those military titles to civilian ones; and (c) provide counts of civilian incumbents and identify their demographic characteristics—at least age and sex—in each matched occupation.

Two existing crosswalks between national occupational systems provide the input data for (a) and (b). The first critical input—an OASD/MI&L crosswalk—matches military jobs to the *Dictionary of Occupational Titles* (DOT) categories. The second—the National Occupational Information Coordinating Committee (NOICC) match—links DOT titles to Standard Occupational Classification (SOC) codes, which in turn are linked to 1980 Census occupational classifications. The procedures are summarized below:



These steps, which pass through different occupational coding schemes, end with military jobs linked to 1980 Census occupational codes. With militarily relevant jobs so identified, the 1980 Census PUMS can provide incumbent counts and incumbent demographic characteristics.¹

THE OASD/MI&L CROSSWALK

The OASD/MI&L crosswalk identified 5,535 military jobs in the Army, Air Force, Navy, Marine Corps, and Coast Guard. (The DoD's occupational

1. Occupational Employment Services (OES) data were considered by the Working Group as an alternative to 1980 Census data for incumbent counts. However, national OES provides no information on the age or sex of incumbents, and state-specific data are not available in standardized machine-readable formats. Potential uses of OES for updates are suggested later in this report.

coding schemes—both the DoD Occupation and the Integrated Defense Occupational Stratification (IDOS) codes—are also identified for each military job.) Jobs were defined by both military titles and skill levels (skill levels are defined by either pay grade or rank). Military and civilian job analysts then matched military jobs (using job descriptions) with DOT (fourth edition) occupational titles (again using job descriptions). Up to 12 different DOT titles could be used to define each military job.

Overall, 67 percent (3,723) of the military jobs were successfully linked to at least one DOT title, and the OASD/MI&L crosswalk identified 949 DOT titles (out of a possible 12,130) as militarily relevant (that is, analytically linked to an MOS). Table 4 summarizes these results.

THE NOICC CROSSWALK

The NOICC crosswalk contains three civilian occupational taxonomies that were used in the NMI. Procedurally, the fourth-edition DOT occupations are first walked to the approximately 660 titles in the 1977 Standard Occupational Classification (SOC) system, which groups DOT titles according to descriptions of the work performed. The SOC classifications are then matched to titles in the 1980 Decennial Census occupational system. Both the DOT-to-SOC conversion and the SOC-to-Census conversion were accomplished by analysts reviewing and matching occupation to occupation across systems.

With the final conversion to 3-digit Census codes, persons can subsequently be counted according to their answers to questions on the kind of work they did, their most important activities or duties, and, in some cases, the kind of business or industry in which they worked.

Table 4 shows matches between the two civilian occupational systems in the NOICC crosswalk that are most relevant to the NMI. Although nearly all of the 12,130 DOT titles have been converted to Census codes, only 472 of 503 Census occupations have DOT counterparts. (Most of the detailed Census occupations not converted to DOT titles fall in the broader Census occupational group of postsecondary teachers.)

TABLE 4
OCCUPATIONAL COUNTS FROM THE CROSSWALKS

<u>OASD/MI&L crosswalk</u>		
OSD-defined military jobs	5,535	
No civilian match (not matched to DOT code)		1,812 (33%)
Civilian match (matched to at least one DOT code)		3,723 (67%)
<u>NOICC crosswalk</u>		
DOT codes	12,130	
DOT codes that map uniquely into Census codes ^a		12,090
<u>OASD/MI&L-NOICC crosswalk</u>		
Census occupations	503	
Census occupations that have DOT code or codes ^b		472
<u>DOT codes</u>		
Military match (DOT codes matched in OASD/MI&L crosswalk) ^c		949 (8%)
No military match (DOT codes not matched in OASD/MI&L crosswalk)		11,181 (92%)
<u>Census codes</u>		
Military match (at least one DOT code in Census occupation is militarily relevant)		259 (55%)
No military match (no DOT code in Census occupation is militarily relevant)		213 (45%)

- a. There are 29 DOT codes on the OASD/MI&L crosswalk which are not on the NOICC crosswalk. (The NOICC crosswalk is our basic source for relating one set of civilian occupational codes to another.) A *Supplement* to the *Dictionary of Occupational Titles, 4th Edition* (U.S. Department of Labor, Employment and Training Administration, 1982) includes these codes. Two militarily relevant DOT codes (scuba diver and college teacher) do not map uniquely to one Census occupation; these two specialties have not been coded.
- b. There are 472 Census occupations with DOT (4th edition) matches. The other 31 Census occupations have no DOT codes. The fact that over 12,000 DOT job title codes map into only 472 of 503 Census job titles is an example of the difference in occupational taxonomies.
- c. In other words, the 3,723 military jobs utilized 949 DOT classifications.

THE OASD/MI&L-NOICC CROSSWALK

Using the fourth-edition DOT occupational codes, the OASD/MI&L and NOICC crosswalk files were linked by computer. The OASD/MI&L-NOICC crosswalk thus includes all military titles (from the OASD/MI&L file) and all civilian titles (from the NOICC file), and identifies the militarily relevant civilian titles. As seen in table 4, the OASD/MI&L crosswalk results in 55 percent of Census titles with DOT counterparts identified as militarily relevant. Figure 1 illustrates the use of the military input, the Census output, and the DOT common denominator, and shows the relative proportions of matched occupations across the key taxonomies. For simplicity, the intervening NOICC step—from the DOT through the SOC system to the Census—is omitted from this figure.

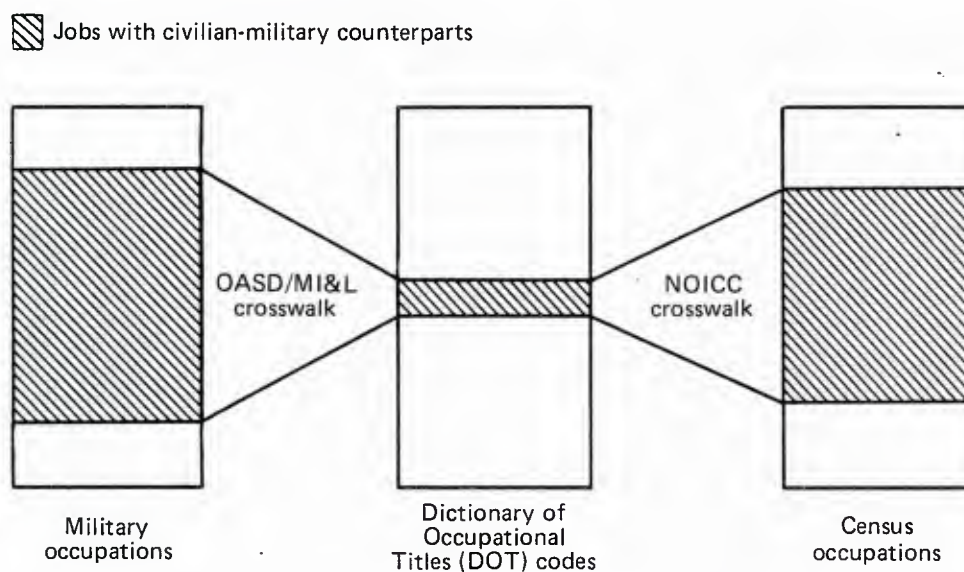


FIG. 1: ILLUSTRATION OF CROSSWALK RESULTS

In summary, the basic OASD/MI&L crosswalk was able to find a corresponding DOT title for 67 percent of the military jobs. For these 3,723 jobs, 949 (or 8 percent) of the DOT titles were used. Finally, using the NOICC crosswalk to translate these DOT titles into Census job titles, 55 percent of the Census titles (with DOT counterparts) were identified as militarily relevant.

CNA-CONSTRUCTED OCCUPATIONAL DICTIONARY FILES

The principal working file of the CNA-constructed occupational dictionary is organized by Census occupational codes. Under each Census code, the DOT codes that compose it are listed. If a DOT code has been identified as militarily relevant, the military jobs associated with it also are listed. This organization is illustrated schematically below; appendix A reproduces actual portions of the file.

Census occupation code₁ and title₁
 DOT₁
 MOS, DoD code, IDOS codes, title of military job, gender
 restrictions
 DOT₂
 .
 .
 .
 DOT_n
Census occupation code₂ and title₂ (etc).

Ancillary files, organized roughly like the basic file but sorted by DOT, MOS, DoD, or IDOS codes, were also constructed.

Analysis of these dictionary files has revealed some limitations of the resultant civilian/military job matches. Some problems arise from DOT taxonomy: despite the large number of occupational titles, some civilian occupations are simply not described in the DOT. More frequently, however, problems arise from the differences between classification systems and the necessity to move through these different classification systems to achieve MOS/Census occupation matches. Potential problems caused by this indirect procedure are, not surprisingly, somewhat more difficult to pinpoint than those caused by the DOT taxonomy.¹ However, the following observations can be made about the resultant OASD/MI&L-NOICC crosswalk.

1. Possible sources of error in the fourth-edition DOT are documented in Miller et al., 1980. See *National Manpower Inventory Final Report, Volume II: Technical Appendixes*, appendix A, for a more detailed documentation of the OASD/MI&L-NOICC crosswalk.

Available data do not allow precision in counting civilians with militarily relevant skills because of the translations across systems with different occupational boundaries and aggregation levels. Among the problems with the results obtained with the methodology of the MOS/DOT/SOC/Census crosswalk discussed above, the most important is that a substantial and uneven overcount of individuals with militarily relevant skills is produced.

Under the methodology, many DOT jobs can be, and are, matched to a single Census title. That in itself is not a problem, since many jobs involve various kinds of work and many DOT titles are narrowly defined. For most Census titles, however, the result is that only a small fraction of the matched DOT titles have been determined to be militarily relevant.

Differences in the historical roots and purposes of the two taxonomies have led to differences in occupational detail. For example, the Census system provides greater detail on types of postsecondary teachers than the DOT does, whereas the DOT classifications for operative jobs in manufacturing are far more precise than those of the Census. The numbers of persons employed varies considerably by occupational title in both systems. However, the DOT system contains many more titles that describe the jobs of fewer than 25,000 to 50,000 (of the roughly 100 million) U.S. workers than does the Census.

Some insight into sources of the overcount problem can be gained by looking at the proportions of DOT titles identified as being militarily relevant within any Census occupation. Using the 472 Census occupations matched to DOT codes on the OASD/MI&L-NOICC crosswalk file as the unit of analysis, here is an overview of the result:

<u>Percent of militarily relevant DOTs in the Census occupation</u>	<u>Percent of 472 Census occupations that have DOT equivalents</u>	<u>Percent of the 259 Census occupations identified by DOT match as militarily relevant</u>
90-100	5.7	10.6
80-89	0.4	0.8
70-79	1.5	2.7
60-69	1.7	3.1
50-59	2.1	3.9
40-49	5.3	9.8
30-39	6.8	12.5
20-29	8.5	15.3
10-19	10.4	18.8
0.1-9	2.3	22.4
None	45.1	N/A

The third column describes those Census occupations identified as militarily relevant. For 10.6 percent of those occupations, 90 percent or more of their NOICC-matched DOT codes were shown as militarily relevant in the OASD/MI&L crosswalk. However, only 21 percent of the 259 Census titles have 50 percent or more of their associated DOT codes flagged as being militarily relevant. In contrast to the apparently strong civilian-military fits identified by the top rows, the bottom rows show that 41 percent of the matched Census occupations have less than 20 percent of their DOT codes identified as militarily relevant. Overcounts of skilled civilians will occur when incumbents of irrelevant DOT jobs are "pulled in" along with those of relevant DOT jobs, via their matches to a Census occupation. Because the number of persons employed varies by occupation, proportions of militarily relevant titles cannot be translated to proportions of occupational incumbents. These distributions by title illustrate, however, the key source of the overcount problem.

Despite these known problems, the OASD/MI&L-NOICC crosswalk is a substantial improvement over earlier attempts to link civilian incumbents with military jobs. In addition to providing a critical link for the National Manpower Inventory model, it has facilitated a better understanding of how a crosswalk addressing mobilization questions should be designed. Since the NMI software is flexible, the user can substitute another crosswalk should one that addresses mobilization questions more directly become available.

UPDATING THE 1980 CENSUS INFORMATION: SOME OPTIONS AND AN EMPIRICAL STRATEGY

The advantages of the 1980 Decennial Census as the basic database have been stressed elsewhere in this report. Relative to other large occupational databases, its wealth of demographic and geographic detail allows estimation of numbers of skilled civilians using age, sex, education, or geographic restrictions.¹ The disadvantage, however, is that the information is from 1980 and, therefore, dated. There is, in fact, a continual need to update the information; for some purposes, it may be worthwhile to forecast occupational incumbents. A question that arose early in the development of the NMI model was how much effort to devote to this task. Considerable resources were spent determining what data were available for updating or forecasting. As a result of that search, it became apparent that forthcoming improvements in the collection of data that are occupationally compatible with the 1980 Census would make a large update/forecast effort premature at this time. Thus, it was decided to postpone a major update until such information is available.

However, an update module has been developed for the NMI model. Update factors in that module are the ratio of the experienced civilian labor force (ECLF) in December 1983 to the ECLF in 1980. The following describes data inputs and procedures used to calculate these factors.

1980 DATA

Published occupational estimates for the ECLF, by sex, from the 1980 Census provide the basic 1980 input information.² A small number of detailed 3-digit occupations have been aggregated so that detail is available for only 482 of the 503 occupations in the 1980 classification system. (Since published data include both reservists and disabled workers, these counts will differ from those for 1980 in the major NMI model.)

1. The inventory can be defined additionally by labor force status, industry of employment, class of worker, veteran status, and state of residence.

2. The 1980 Census data are from *Summary Volume: Characteristics of the Population* (U.S. Department of Commerce, Bureau of the Census, 1984, table 276).

1983 DATA

The Current Population Survey (CPS), conducted by the Bureau of the Census for the Bureau of Labor Statistics (BLS), Department of Labor, is the source of our update data. Since the monthly CPS first adopted the 1980 Census classification system in its January 1983 survey (Green et al., 1983), update data are similarly coded. However, incumbent counts at the most detailed occupational levels are considered unreliable when estimated from any single monthly sample (roughly 60,000 households), and BLS publishes employment estimates, by sex, only for larger occupational groups. Estimates for the module update factors are for 43 occupations in December 1983 (*Employment and Earnings*, January 1984, table A-21). They are not disaggregated by geographic or any other demographic characteristic.

Unlike the 1980 Census data, these occupational estimates for 1983 are available only for the employed. However, combined with information on unemployment by occupation, one can reconstruct the appropriate ECLF counts for 1983. (For experienced workers, the occupation-specific labor force level equals the unemployed plus the employed in any given occupation.)¹

Unemployment rates for December 1983 are available by sex only for 16 relatively general occupational categories (*Employment and Earnings*, January 1984, table A-11), but the sample size is too small for women's unemployment in 1 of the 16 groups. Thus, 15 distinct occupational groups are available to reconstruct occupational unemployment and ECLF distributions for December 1983.²

Using these data, the formula for the factors in the NMI occupational update module is as follows:

1. Fortunately, the labor force concepts used in the 1980 Census and the monthly CPS are generally comparable.

2. The strategy was to assume that the unemployment experience of each of the sex-specific general occupational categories would give a reasonable description of the experience of the subgroups it summarized. But because the different labor markets for more narrowly defined occupational levels are averaged into the larger labor market under this procedure, the assumption is not ideal.

$$\text{Update factor}_{ij} = \frac{\text{Employed}_{ij,83} / 1 - \text{Unemployment rate}_{ij,83}}{\text{Experienced civilian labor force}_{ij,80}}$$

$$= \frac{\text{Experienced civilian labor force}_{ij,83}}{\text{Experienced civilian labor force}_{ij,80}}$$

where

i = gender

j = occupation.

These update factors assume that the growth in the experienced civilian labor force is independent of other factors, such as age of incumbents, geography, or industry of employment. These assumptions were necessary because other information we examined — either for updating or for forecasting — is currently based on different and noncompatible occupational codes. Fortunately, however, potentially better data are forthcoming; the most promising of these in terms of occupational detail are from the Occupational Employment Statistics (OES) system.

OCCUPATIONAL EMPLOYMENT STATISTICS DATABASES

In its Occupational Employment Statistics program, the Bureau of Labor Statistics collects national data from employers on a 3-year cycle.¹ The 1979-1981 OES survey data, obtained in machine-readable form from the BLS, have total incumbent estimates by occupation and industry. The OES occupational coding scheme in the 1979-1981 survey years has about 1,700 occupational codes. Each of these occupational codes has a distinct set of *Dictionary of Occupational Titles* (DOT) codes associated with it; theoretically it is possible to match military jobs (coded into civilian jobs by DOT codes) into both the OES and the Census occupational coding schemes. Unfortunately, the 1979-1981 OES occupational taxonomy did not crosswalk cleanly with 1980 Census codes. Despite the fact that there are over 1,700 OES codes and

1. For an overview of the program, see the Bureau of Labor Statistics' *Occupational Employment Statistics Handbook* (U.S. Department of Labor, April 1979). Goldstein (1971) provides an introduction to the intent and rationale underlying the OES survey.

only 503 Census codes, one OES code can crosswalk to multiple Census codes. Figure 2 illustrates the problem.

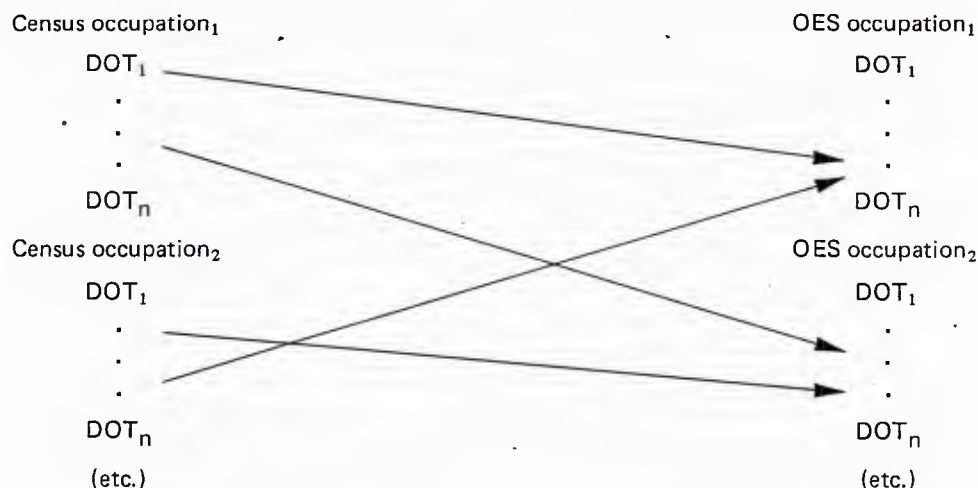


FIG. 2: THE CROSSWALK BETWEEN 1980 CENSUS OCCUPATIONAL CODES AND THE 1979-1981 OES OCCUPATIONAL TAXONOMY

Since there is no current information on incumbents by DOT category, it is impossible to integrate OES/Census occupational taxonomies and use OES-based data for forecasts of employment growth or decline.¹

The current OES survey (1983) is using a new occupational taxonomy based on the new Standard Occupational Classification (SOC) system. Since the 1980 Census is also based on the SOC, crosswalks between the systems should be greatly facilitated. Because it takes 3 years to complete the survey, however, the 1983-1985 wave of OES data with the new occupational classification scheme will not be available until 1986. In 1986, it will be possible to update and to forecast the inventory on an occupation-by-industry

1. For example, suppose that the growth projected for 1995 is 10 percent for OES occupation 1 and 6 percent for OES occupation 2. Census occupation 1 has some incumbents from OES occupation 1 and some incumbents from OES occupation 2, but since the relative proportions are unknown, we cannot determine the projected growth rate for Census occupation 1.

level, incorporating assumptions about incumbent age and sex, as appropriate.¹ Thus, it is prudent to postpone any serious forecasts until 1986.² Alternatives to OES occupational data were considered, but these provide either incomplete or potentially misleading information and would be relatively time-consuming to use. These alternatives are described briefly below.

ALTERNATIVE DATABASES

The industry codes used in the OES program are based upon the same Standard Industrial Classification (SIC) codes as are used in the 1980 Census. However, some codes are aggregated at different levels. If the NMI sponsors had believed that forecasts were a critical part of this stage of the NMI project, BLS industry projections could have been used (and the non-Census-compatible occupational projections ignored). Use of industry projections would have implicitly assumed that each occupation within an industry would grow at the same rate. To calculate occupational growth rates under this assumption, let r_j be the growth rate in the j th industry and o_{ij} be the fraction of occupation i employed in industry j . Then, the growth rate for occupation i is defined as

$$o_{i\cdot} = \sum_{j=1}^J r_j o_{ij} .$$

Unfortunately, the assumption required for this procedure is incorrect. OES Occupation by Industry projections show distinctly different growth rates for different occupations within an industry. Moreover, the NMI

1. The BLS Occupation by Industry projections also will employ the new OES occupational classifications. However, the Census (and other household surveys) measure people in jobs, whereas the OES survey measures jobs. Primarily because of multiple job holding, total employment as measured in the OES is higher than in the Census (see, e.g., Carey, 1981: 54), and the effect on employment is not equal across occupations. Thus, even with the greater compatibility in occupational classifications, updating the 1980 Census counts with OES data will not be a simple procedure.

2. As this study was being completed information became available indicating that the Bureau of Labor Statistics is facing potential funding problems with the OES survey (see Congressional Research Service, 1985: 37).

Working Group decided that it would be unwise to compound the normal forecasting error with an erroneous assumption, particularly if additional assumptions about incumbent demographic characteristics were required.

Data from other sources, in particular those from state employment offices, appeared initially promising. State data, although potentially a very rich source, are currently neither standardized nor universally machine-readable, and thus not feasible for use in a national inventory at this juncture.

DATA ON CIVILIAN TRAINING PIPELINES

Although occupation is the key measure of skill for mobilization supply, there are limitations to occupational measures as proxies for skill, especially for the youngest members of the labor force.¹ Since individuals in training and those who have recently completed training clearly are potential assets to mobilization, the National Center for Education Statistics (NCES) was consulted on the availability of current data describing persons in higher education or training programs.

In response to their Congressional mandate for ongoing data collection, in the early 1980s the NCES instituted a new classification scheme, called the Classification of Instructional Programs (CIP), for their major data collection efforts.² Two ongoing NCES surveys, which both use CIP instructional codes, appear promising to the NMI program. About 1,100 6-digit codes in the CIP have been matched to relevant military occupations with the OASD/MI&L crosswalk. Unfortunately, current data from neither survey have been completely assembled. Because of this, a pilot project with the subset of data that was available was undertaken. In this pilot project, fields of study for school completions were matched to military occupational specialties, resulting in preliminary estimates of the recruitment pool provided by educational institutions for two states.

1. At any given time, many young people are seeking their first job or a job utilizing newly acquired skills. If they have not previously worked, they are not included in occupational counts, because statistics on the unemployed by occupation are limited to unemployed persons who have previously held a job, which allows an occupational classification. Thus, unemployment by occupation excludes "substantial numbers of persons seeking their first regular job" and may misclassify others if the occupation of their most recent job differs from the work they are currently seeking (National Commission on Employment and Unemployment Statistics, 1979: 110-111).

2. A new coding was necessary primarily because of newly formulated programs of study. For more information on the new coding scheme (as well as a listing and description of the individual codes), see U.S. Department of Education, Office of Educational Research and Improvements, National Center for Education Statistics, *A Classification of Instructional Programs*, February 1981. It is this new coding scheme, CIP, which the OASD/MI&L crosswalk coded to military occupational specialties. Examples of the CIP coding scheme for selected programs are provided in volume II of this report, appendix E.

These estimates permit an examination of the relevance of NCES databases for projects like the NMI. These data should potentially allow manpower analysts to locate skilled labor pools geographically with considerably more precision than has been possible in the past.

TRAINING DATA SOURCES

The two NCES survey programs described here are the Vocational Education Data System (VEDS) and Higher Education General Institution Survey (HEGIS). Similarities and differences in these two data sets collected by NCES are summarized in table 5.

TABLE 5
COMPARISON OF HEGIS AND VEDS SURVEY DESIGNS

Characteristic	VEDS	HEGIS
Method of collection	State education offices	Institutions of higher education
Frequency of collection	Regularly	Yearly
Programs detailed		
Schooling level	Secondary and post-secondary	Higher education only
Schooling type	Includes nontraditional	Higher education only
Type of data		
Program classification	CIP	CIP
Program coverage	Vocational only	Higher education only
Personnel	Enrollments & completion	Completions
Geographic detail	State	Precise location (ZIP)
Demographic detail	Sex and race	Sex; race in alternate years ^a

a. The 1980-1981 and the 1982-1983 HEGIS data will have information on both sex and race; the 1981-1982 has information only on sex.

Students in Vocational Training

The Vocational Education Data System (VEDS) survey is required by law: under the NCES mandate, data must be collected on *all* students in vocational training programs that receive Federal funds.

Four "streams" of information for vocational students are collected. The first stream consists of information on secondary school students in vocational training programs. The other three streams all consist of information about students in the following types of postsecondary school programs: (1) regionally accredited vocational training programs (usually two-year public colleges but also some state-supported four-year colleges that provide vocational training); (2) state-created vocational training programs (about 30 states have such arrangements); and (3) other vocational training programs (a residual category that encompasses a wide variety of programs, including vocational training programs run by public school districts in the evening).

The 1982-1983 VEDS survey year was the first to require the new CIP classification scheme. Of the 1,100 CIP categories, about 400 are relevant for vocational training.¹ Unfortunately, the 1982-1983 VEDS database has not been publicly released.² Although the data for about 40 states are estimated to be about 99 percent complete, a computer tape has not yet been prepared. Apparently there are problems with public release of the data; it is not clear at this time when these problems will be remedied. If, however, there is interest in adding such information to recruitment sources, an alternative to the NCES consolidated data set may be information obtained directly from the state education offices responsible for NCES data collection. The NMI effort at CNA did not pursue this option.

In addition to the vocational information, the VEDS data at NCES include race and sex of the trainees in each state. The data, however, contain no information on the ages of the individuals in the programs nor on precise geographic locations, although the states in which individuals are being trained for the different vocational specialties are identified.

1. The VEDS form is sent to state education offices. These offices aggregate data for the state and then submit these data to NCES. For *secondary* vocational training, NCES officials believe the VEDS survey is a virtual census of students in vocational training.

2. It should be noted that there was no VEDS survey in the 1983-1984 academic year, but it is expected there will be a survey in either 1984-1985 or 1985-1986.

Students in Institutions of Higher Education

Institutions of higher education (numbering about 3,400) are surveyed with the HEGIS forms; as with the VEDS data, the 1982-1983 survey was the first to employ the CIP taxonomy universally. Unfortunately, transfer of the data from the paper copy into machine-readable form has been delayed. However, NCES officials were able to provide the completed 1982-1983 data for two states—Maryland and Illinois.

HEGIS data are collected by "award category" for students in all higher education institutions. (Award categories are defined by the length of the educational program: degree program less than one year, associate degree, etc.) By selecting appropriate course lengths and vocational program CIP codes, it is possible to draw virtually the same universe from the HEGIS data as can be found in the VEDS data. The VEDS data, however, as noted above, include a wider range of institutional arrangements for vocational training than HEGIS, which is restricted to institutions of higher education. However, HEGIS data do provide precise geographic locations for the whole country, and the data are not restricted to programs that receive Federal funding.¹ Because the National Center for Education Statistics' HEGIS data contain more geographic detail than VEDS, they may be more directly useful to military manpower planners than VEDS data.²

COUNTING VOCATIONAL TRAINING STUDENTS BY THEIR MILITARY JOB CLASSIFICATION

The CIP codes have been cross-coded to the fourth-edition *Dictionary of Occupational Titles* (DOT) codes as well as the Standard Occupational Classification (SOC) codes. As noted earlier, the OASD/MI&L cross-code

1. It should be remembered, however, that the data are collected somewhat differently (HEGIS forms go directly to the institutions, whereas VEDS forms go to the state education offices).

2. As this study was being completed, information became available about a new system of data collection being initiated by NCES. The Integrated Postsecondary Data System (IPEDS) will integrate three current data sources (VEDS, HEGIS, and the special-purpose noncollegiate postsecondary data system). The first component of the new system, the collection of institutional characteristics, is scheduled to begin in the fall of 1985. The remaining elements of the program will be introduced on a flow basis beginning in 1986. (See Congressional Research Service, 1985: 83-85.)

(crosswalk) project matched military occupational specialties to DOT codes, providing the information necessary to match military jobs to civilian training pipelines. Using these links and the 1982-1983 academic year HEGIS data for Illinois and Maryland, the potential of the NCES data could be explored.

The initial effort focused on higher educational programs of two years or less in duration. This effort is thus restricted to the enlisted community. The data (CIP codes matched to military specialties at the 2-digit DoD occupational code level) are presented in table 6. As the table indicates, there appears to be a significant number of civilian training programs that teach skills relevant for military jobs. Because it is a larger state, Illinois has more students in each DoD occupational category. The distributions of students among codes are fairly similar for these two states, although there are some differences between the states by program. Almost 6 percent of Maryland's students, for example, are found in Law Enforcement (DoD Occupational Code 83), whereas this code accounts for less than 2 percent of Illinois completions. Even with these data from only two states, the value of their geographic detail can be quickly recognized.

Figures 3 through 7 illustrate the type of geographic detail that is possible with these data. The figures show student concentrations for particular militarily relevant programs by counties. Since the HEGIS data contain exact geographic location for the institutions, even more geographic detail is possible.

Figure 3 details the geographic distribution of individuals who completed programs in Electronic Equipment Repair. (All data are for programs of two years or less in duration.) This 1-digit DoD occupational code includes specialists in the maintenance and repair of various types of electronic and allied equipment (radio, radar, navigation, weapons, and computers, among others). Figure 4 shows the geographic distribution for a 2-digit DoD occupational code, Communications Center Operations, for Illinois. This occupation, classified under the 1-digit code of Communications and Intelligence Specialists, includes the receipt and distribution of messages, the operation of communications center equipment, and the operation of major field communications systems. Figure 5 shows the concentrations of individuals in Illinois who completed medical care tracking programs (excluding dental).

TABLE 6

**CIVILIAN TRAINING PROGRAM COMPLETIONS BY DOD
ENLISTED OCCUPATIONAL CODES^a**

<u>DoD enlisted occupational codes</u>	<u>Number of completions (1982-83)</u>	
	<u>Illinois</u>	<u>Maryland</u>
0. Infantry, Gun Crews, and Seamanship Specialists	813	77
01. Infantry	32	0
02. Armor and Amphibious	0	0
03. Combat Engineering	45	19
04. Artillery/Gunnery, Rockets & Missiles	212	4
05. Air and Crew	422	17
06. Seamanship	73	37
07. Installation Security	29	0
1. Electronic Equipment Repairmen	42,264	7,439
10. Radio/Radar	12,351	2,150
11. Fire Control Electronics Systems (Nonmissile)	7,153	1,246
12. Missile Guidance, Control & Checkout	5,001	887
13. Sonar Equipment	2,489	421
14. Nuclear Weapons Equipment	2,261	404
15. ADP Computers	2,511	421
16. Teletype & Cryptographic	2,535	452
17. Other Electronic Equipment	7,993	1,458
2. Communications & Intelligence Specialists	14,496	2,518
20. Radio & Radio Code	2,671	392
21. Sonar	2,261	404
22. Radar & Air Traffic Control	2,410	441
23. Signal Intelligence/Electronic Warfare	2,550	404
24. Intelligence	250	2
25. Combat Operations Control	149	37
26. Communications Center Operations	4,175	838
3. Medical & Dental Specialists	5,351	1,090
30. Medical Care	3,738	481
31. Technical Medical Services	646	226
32. Related Medical Services	210	95
33. Dental Care	757	288

TABLE 6 (Continued)

<u>DoD enlisted occupational codes</u>	<u>Number of completions (1982-83)</u>	
	<u>Illinois</u>	<u>Maryland</u>
4. Other Technical & Allied Specialists	1,513	398
40. Photography	261	122
41. Mapping, Surveying, Drafting & Illustrating	585	175
42. Weather	190	1
43. Ordnance Disposal & Diving	0	0
45. Musicians	0	0
49. Technical Specialists, N.E.C. ^b	477	100
5. Functional Support & Administration	20,025	3,060
50. Personnel	2,101	275
51. Administration	2,401	333
52. Clerical/Personnel	332	4
53. Data Processing	4,105	748
54. Accounting, Finance, & Disbursing	507	8
55. Other Functional Support	5,786	872
56. Religious, Morale, & Welfare	2,355	362
57. Information & Education	2,438	458
6. Electrical/Mechanical Equipment Repairmen	23,472	3,448
60. Aircraft & Aircraft Related	6,348	933
61. Automotive	1,949	174
62. Wire Communications	2,861	470
63. Missile Mechanical & Electrical	4,740	809
64. Armament & Munitions	4,777	812
65. Shipboard Propulsion	1,352	157
66. Power Generating Equipment	1,113	31
67. Precision Equipment	133	31
69. Other Mechanical & Electrical Equipment	199	31
7. Craftsmen	5,588	194
70. Metalworking	2,496	51
71. Construction	1,793	43
72. Utilities	701	100
74. Lithography	133	0
75. Industrial Gas & Fuel Production	0	0
76. Fabric, Leather, & Rubber	2	0
79. Other Craftsmen, N.E.C. ^b	463	0

TABLE 6 (Continued)

DoD enlisted occupational codes	Number of completions (1982-83)	
	Illinois	Maryland
8. Service & Supply Handlers	8,522	2,348
80. Food Service	3,735	716
81. Motor Transport	135	74
82. Material Receipt, Storage & Issue	2,683	395
83. Law Enforcement	1,924	1,144
84. Personal Service	0	0
85. Auxiliary Labor	45	19
86. Forward Area Equipment Support	0	0
87. Other Services	0	0
9. Nonoccupational	189	19
90. Patients & Prisoners	0	0
91. Officer Candidates and Students	0	0
92. Undesignated Occupations	0	0
95. Not Occupationally Qualified	189	19

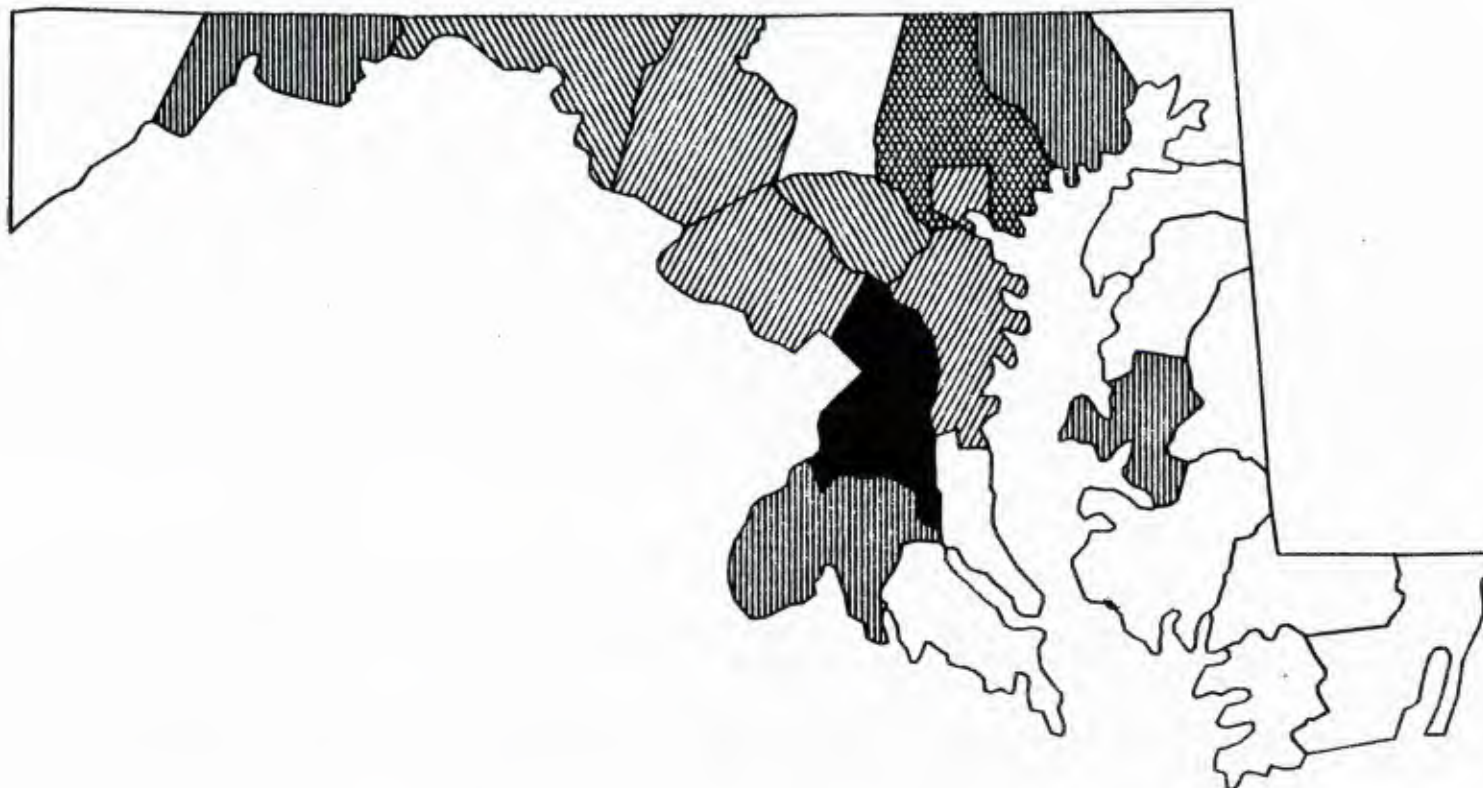
a. The HEGIS data for Illinois and Maryland were obtained from the National Center for Education Statistics. The CIP program codes were matched to the DoD enlisted occupational codes by the OASD/MI&L crosswalk. The table reports completions for programs two years or less in duration.

b. Not elsewhere classified.

Figures 6 and 7 show the geographic distribution of individuals, in Maryland and Illinois respectively, who completed programs in Electrical/Mechanical Equipment Repair. Maryland data reflect distributions at the 1-digit level (code 6); the Illinois data are restricted to a more specialized group whose courses focused on aircraft and aircraft-related repair (code 60).

In summary, a potentially up-to-date and relatively complete source for identifying pipelines into the military at the apprenticeship level may soon exist. It appears worthwhile to integrate this NCES information into military manpower data systems. Moreover, since collection of enrollment and completion data by NCES is an ongoing effort, it is probably worthwhile to invest resources in the investigation of the potential of these data for recruitment purposes, both in peacetime and under mobilization. However, since a complete data set is not available at this time, we have not attempted to integrate data on civilian training pipelines into the NMI model.

MARYLAND



LEGEND: CNT

15 TO 60
701 TO 2000

61 TO 200
MORE THAN 2000

201 TO 700

FIG. 3: ELECTRONIC EQUIPMENT REPAIRMAN (DOD OCC CODE 1)

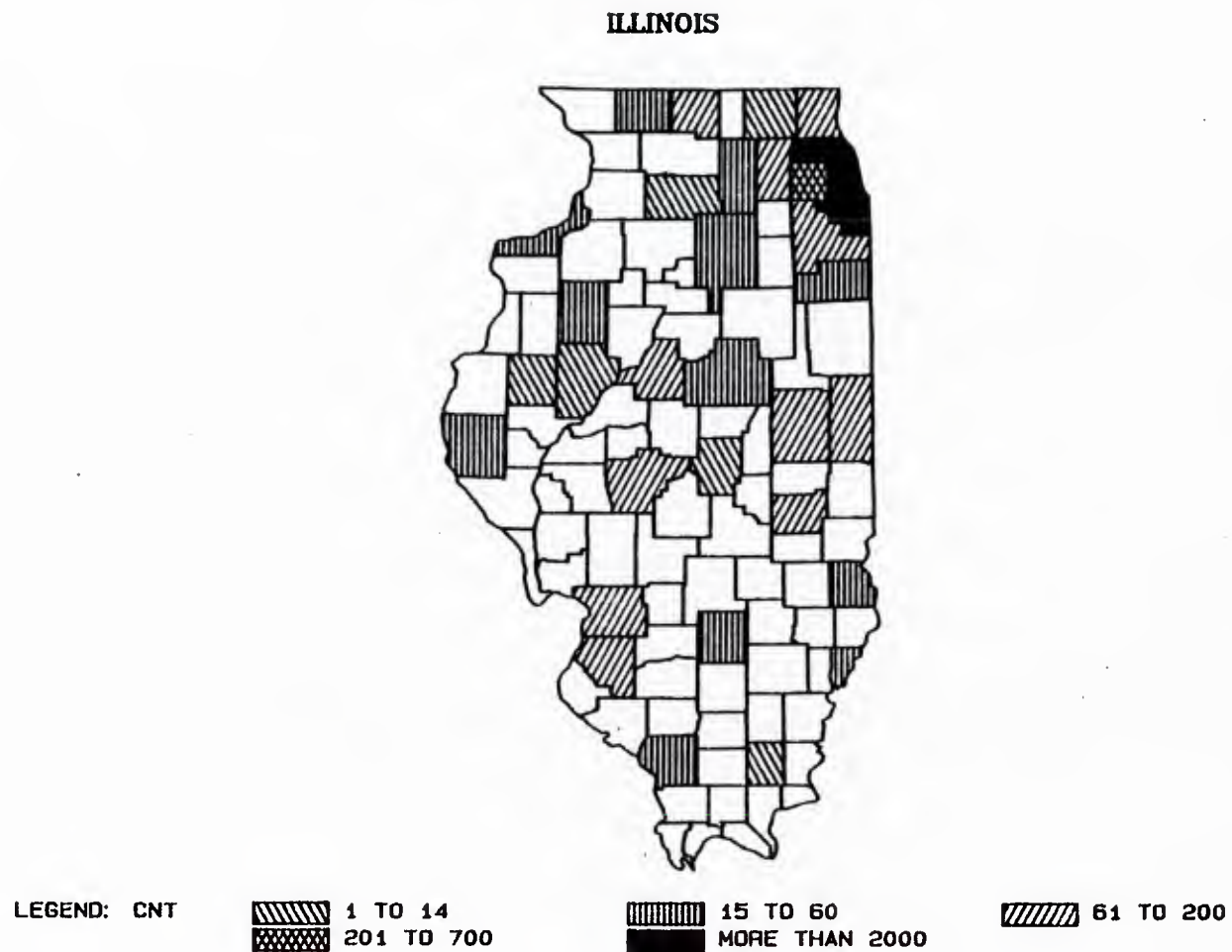


FIG. 4: COMMUNICATIONS CENTER OPERATIONS (DOD OCC CODE 26)

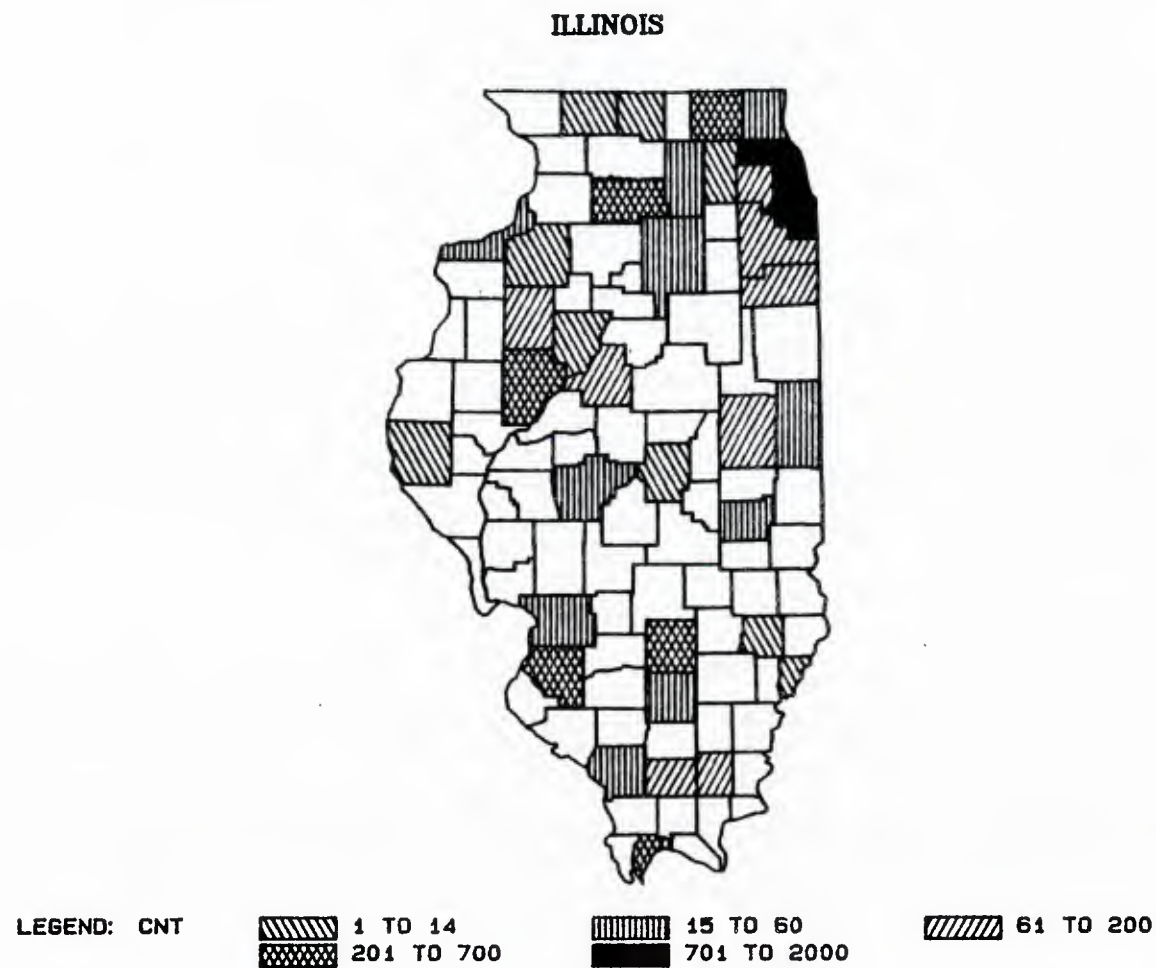


FIG. 5: MEDICAL CARE SPECIALIST (DOD OCC CODE 30)

MARYLAND



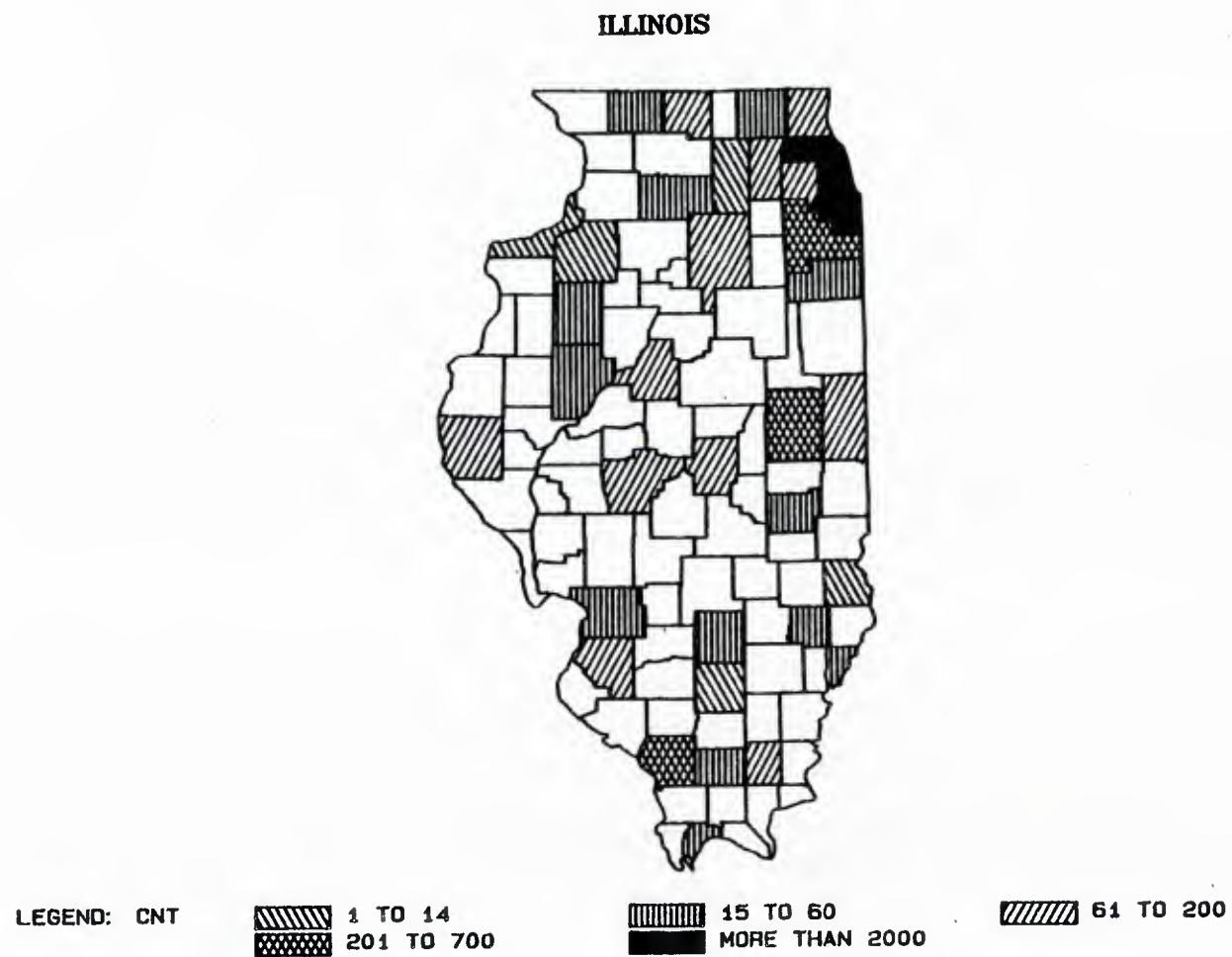
LEGEND: CNT

1 TO 14
201 TO 700

15 TO 60
701 TO 2000

61 TO 200

FIG. 6: ELECTRICAL/MECHANICAL EQUIPMENT REPAIRMAN (DOD OCC CODE 6)



**FIG. 7: AIRCRAFT ELECTRICAL/MECHANICAL EQUIPMENT REPAIRMAN
(DOD OCC CODE 60)**

THE CNA NATIONAL MANPOWER INVENTORY MODEL

Because many different questions will be asked of the NMI system, the computer software is flexible; any of the data sets can be replaced should better information become available. Figure 8 is a diagram showing how the model works. The data inputs, described earlier in this report, are summarized at the top of the figure. The inventory of civilians is organized by a computer program. Users supply specifications appropriate for their needs, and counts (and characteristics, if desired) of skilled civilians will result.

INVENTORY MODIFICATION MODULE

With the inventory modification program, the user can change the civilian input data (by restricting the range of certain variables) and can update the civilian inventory (by changing occupational incumbent counts to 1983 estimates or by deleting reservists). Thus, this program determines what variables will compose the output file to be used by other NMI computer programs.

A sample run of the interactive program is provided below. The software is relatively self-explanatory. Entries appearing in boldface type are the user inputs; other entries are the prompts contained in the software program.

In this example, the user wants to identify civilian occupational distributions by sex and educational level as well as to update the data (by sex and occupation). Since the entire NMI Census data set is so large,¹ most users will input only a subset of the data at any one time. For brevity, the user in this example is working with a modified database containing tabulations by age, gender, education, recent veteran status, and education. For this user, veteran status is not of interest and the age variable is utilized only to restrict the age group in the output data set. The output data set in this example

1. The complete NMI Census data set has tabulations by gender, age, education, veteran status, labor force status, state of residence, race, occupation, and industry. Automatic computer prompts in the full software modification module refer to all of these variables.

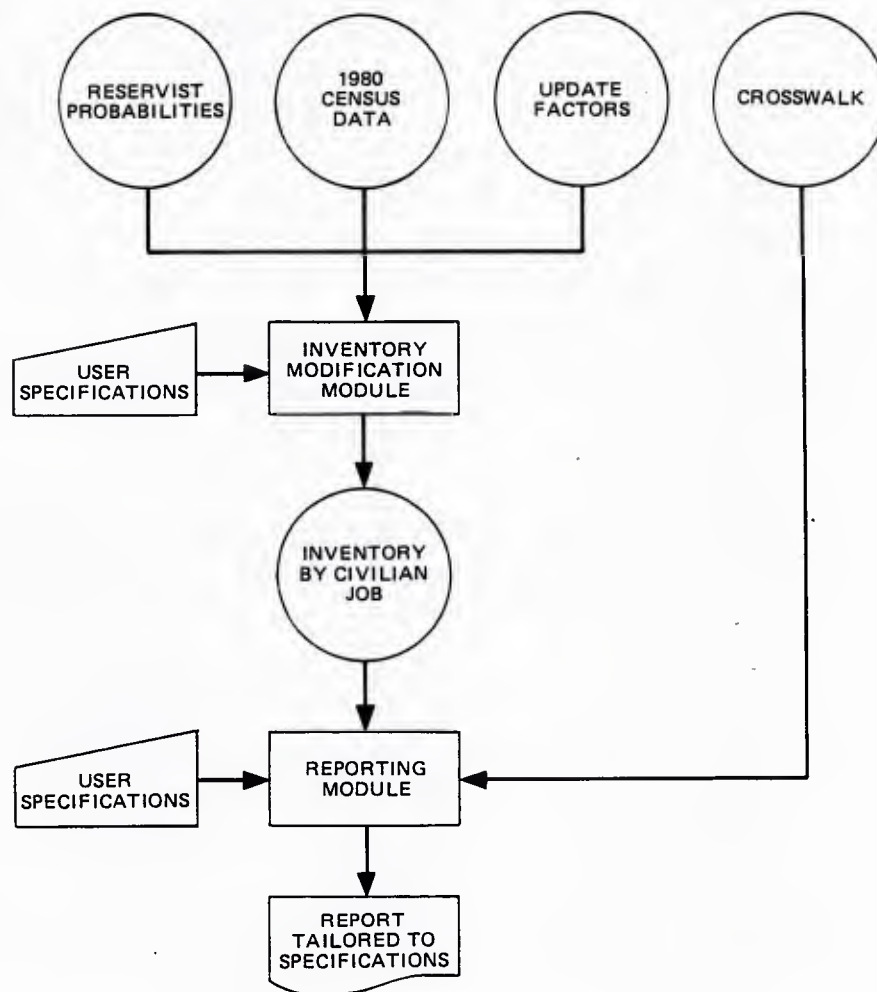


FIG. 8: THE NMI MODEL

contains the civilian occupation, gender, and education variables for the desired age group.¹

Example of Software for Inventory Modification Module

This computer program defines the civilian data set which will be used for the other NMI computer programs. Here, the user can change the civilian inventory (by restricting the range of certain variables) and update the civilian inventory (by changing occupational incumbent counts to 1983 values or by deleting reservists). Finally, this program determines what variables will compose the output file to be used by other NMI computer programs.

Input field:

AGE GROUP

1

11

Should this variable be kept?

Note: Keep this variable if the inventory count will be restricted to certain values of the variable or if the variable will be included in the resulting output tabulation of civilians.

(ENTER Y OR N): Y

Will the values of this variable be restricted to a certain range?

(ENTER Y OR N): Y

Enter new minimum value: 1

Enter new maximum value: 5

Will this variable be included in the output tabulation?

(ENTER Y OR N): N

Input field:

SEX

1

2

Should this variable be kept?

Note: Keep this variable if the inventory count will be restricted to certain values of the variables or if the variable will be included in the resulting output tabulation of civilians.

(ENTER Y OR N): Y

Will the values of this variable be restricted to a certain range?

(ENTER Y OR N): N

Will this variable be included in the output tabulation?

(ENTER Y OR N): Y

1. If the civilian count is to be restricted to males, the user would restrict the range of the gender variable in this step. If, instead, the gender restriction is to follow military gender restrictions, the user would retain the gender variable in this step (but not restrict its range). Then in the next step (the reporting module), the user would match both gender and civilian occupation to the crosswalk, effectively requiring both a gender and an occupational match. When the match is specified for both gender and occupation, military gender restrictions will be enforced.

Input field:

EDUCATION

1

6

Should this variable be kept?

Note: Keep this variable if the inventory count will be restricted to certain values of the variables or if the variable will be included in the resulting output tabulation of civilians.

(ENTER Y OR N): Y

Will the values of this variable be restricted to a certain range?

(ENTER Y or N): N

Will this variable be included in the output tabulation?

(ENTER Y OR N): Y

Input field:

RECENT VET

1

2

Should this variable be kept?

Note: Keep this variable if the inventory count will be restricted to certain values of the variables or if the variable will be included in the resulting tabulation of civilians.

(ENTER Y OR N): N

Input field:

CENSUS OCCUPATION

1

889

Should this variable be kept?

Note: Keep this variable if the inventory count will be restricted to certain values of the variables or if the variable will be included in the resulting output tabulation of civilians.

(ENTER Y OR N): Y

Will the values of this variable be restricted to a certain range?

(ENTER Y OR N): N

Will this variable be included in the output tabulation?

(ENTER Y OR N): Y

You now have the following civilian Census tabulation fields:

- 1 AGE GROUP
- 2 SEX
- 3 EDUCATION
- 5 CENSUS OCCUPATION

Do you wish to update the data?

(ENTER Y OR N): Y

Update matrix field:

SEX

Enter number of corresponding field from input Census tabulation

(Enter 0 to see list of input tabulation fields again;

Enter -1 if no corresponding field): 2

Update matrix field:
CENSUS OCCUPATION

Enter number of corresponding field from input Census tabulation
(Enter 0 to see list of input tabulation fields again;
Enter -1 if no corresponding field): 5

REPORTING MODULE

After the user has finished describing the restrictions and updates desired for the inventory, the computer program will output the inventory of civilians, broken down into the various categories specified by the user. This inventory is then transferred as a file to another software package, a package which will develop the reporting module.¹

The example below shows how the software that accompanies the reporting module works. As in the previous example, user entries appear in boldface type. In this example, the user is inputting the file produced from the above example of the inventory modification module; the user wants to identify military occupations by military title (an alphanumeric field) in the reporting module. Additionally, the user wants the counts of matched civilians to reflect gender restrictions for military jobs. Thus, the crosswalk file and the civilian inventory file will be matched on both census occupation and gender. For the report, the user wants tabulations to be broken down by gender and by civilian educational level.

Example of Software for Reporting Module

This module matches the civilian inventory to the crosswalk and organizes the data for the report of individuals by their military skills. The user should note that the crosswalk data set must be sorted by the military skill field that will be used (for example, MOS code, DoD occupational code, etc.).

1. The user could, of course, print out the file produced by the inventory modification module.

CROSSWALK FIELDS:

- 1 BRANCH
- 2 COMMUNITY
- 3 PAYGRADE
- 4 DOD OCC CODE
- 5 MOS
- 6 MIL TITLE
- 7 BRANCH THRU MOS
- 8 BRANCH THRU TITLE
- 9 SEX
- 10 CENSUS OCCUPATION

Which field in the CROSSWALK contains the MILITARY JOB field that you wish to utilize?
(Remember that the crosswalk must be sorted on this field.) Enter number: 6

CENSUS INPUT TABULATION FIELDS:

- 1 SEX
- 2 EDUCATION
- 3 CENSUS OCCUPATION

How many CROSSWALK fields will be matched with the CENSUS INPUT TABULATION?
For example, both SEX and MOS fields would be necessary to obtain counts which reflect
gender restrictions for military jobs: 2

Which CROSSWALK fields will be matched with the CENSUS INPUT field/ fields? Enter
CROSSWALK field numbers (enter 0 to list again): 9 10

Which variable in the CENSUS INPUT TABULATION is SEX ? Enter number (enter 0 to
see Census list again): 1

Which variable in the CENSUS INPUT TABULATION is CENSUS OCCUPATION? Enter
number (enter 0 to see Census list again): 3

How many of the variables below do you wish to report?

- 1 SEX
- 2 EDUCATION
- 3 CENSUS OCCUPATION

2

Which variables do you want in your report?

The order in which you enter the variables reflects the way the tabulation is broken down.

The first variable will be the primary level.

CHARACTERISTIC	1 IS: 1
CHARACTERISTIC	2 IS: 2

Output from the Reporting Module

The user has many options for disaggregating inventory counts. In particular, printed output can be displayed differently from the input restrictions. For example, one could ask for an inventory of persons age 18 to 40, but ask for the output to be broken down by single years of age. The one restriction is that all fields desired for reporting (in this case, age) be fields that were retained when the modified or updated civilian inventory was produced by the inventory modification module.

The example above asked that the tabulations be performed by gender and educational level. The output from this example, written in scientific notation and with subcounts preceding subtotals and totals, for the military job title "Aviation Gasoline Handler" is shown below:

AVIATION GAS HANDLER

EDUCATION	1	3.220E + 02
EDUCATION	2	2.004E + 03
EDUCATION	3	5.796E + 02
EDUCATION	4	1.127E + 02
EDUCATION	5	2.415E + 01
SEX	1	3.043E + 3
EDUCATION	1	3.500E + 01
EDUCATION	2	2.170E + 02
EDUCATION	3	7.000E + 00
EDUCATION	4	1.400E + 01
SEX	2	2.730E + 02
TOTAL		3.316E + 03

The computer output is reproduced exactly. To identify what the codes mean, the user would usually need to consult volume III of this report, *Technical Documentation for Software for the Model*. In this case, however, the codes are numbered in the sequence given in table 1: Education (1 = Not high school graduate, . . . 5 = Six years college) and Sex (1 = Male, 2 = Female).

COUNT OF CIVILIANS

Table 7 provides a portion of the report of civilians who fit the military's gender restrictions and occupational matches for particular MOSs. This inventory is drawn from the civilian pool of the employed, nondisabled population under the age of 40 years. (The complete inventory list by MOS is over 50 pages long. Because of its length, we have not included it in this report.)

Both because geographic location is of interest and because maps provide an alternative way of presenting the data, the NMI Working Group suggested that graphic displays of the NMI inventory be included in this Final Report. Figures 9 through 32 provide information in this form. Even a quick scan across these figures shows considerable variation in the densities of occupational concentrations (for example, for Texas compared to the northeastern states).

Figures 9 to 16 report on Army enlisted and officer military service occupations, figures 17 to 21 report Navy occupations, figures 22 to 28 Air Force occupations, and figures 29 to 32 Marine Corps occupations. As the figures illustrate, there are fairly large variations geographically (as well as across military occupations) in civilian personnel who potentially could fill mobilization requirements.

Since many users, however, will prefer tabular output, table 8 provides examples of possible inventory breakdowns. In addition, appendix C of this volume provides computer-printed output for officer and enlisted occupations for each of the four services. The material provided in table 8 and appendix C are, of course, only examples of the way the output could be organized. Any of the variables in our data set are potentially "keys" around which the inventory can be sorted.

TABLE 7

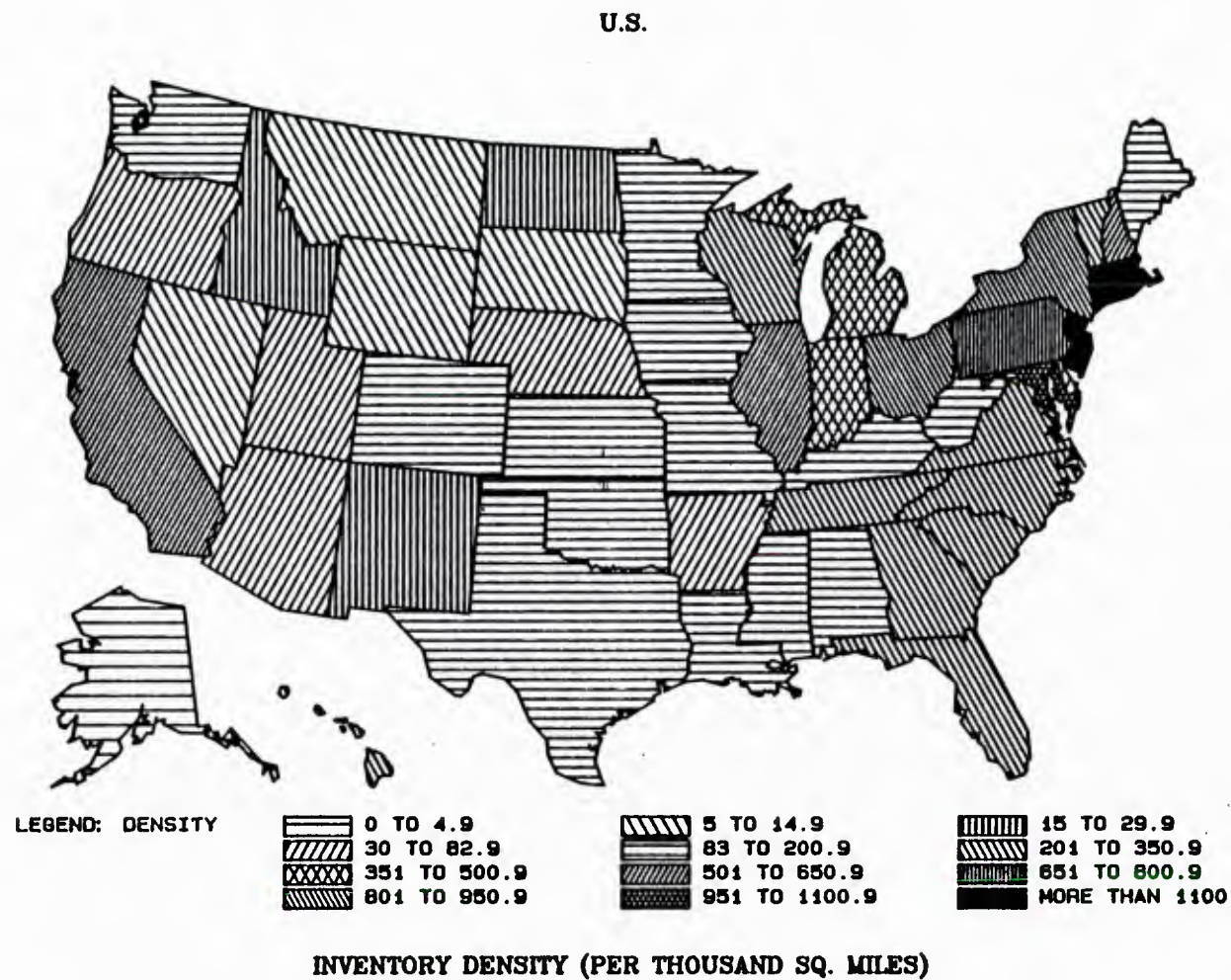
**INVENTORY COUNTS FOR SELECTED MILITARY OCCUPATIONAL
SPECIALTIES, IN THOUSANDS^a**

<u>MOS code</u>	<u>DoD code</u>	<u>Title</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
<u>Army, Enlisted</u>					
12B	030	Combat Engineer	673.4	N.A.	673.4
91C	300	Dialysis Specialty	76.9	45.1	122.0
91C	300	Practical Nurses	10.0	270.1	280.1
71D	512	Legal Clerk	18.2	43.7	61.9
44B	704	Metal Worker	1,389.0	65.0	1,454.0
64C	811	Motor Transport Operator	2,195.8	243.2	2,439.0
<u>Army, Commissioned Officer</u>					
56A	5G	Command and Unit Chaplain	102.8	8.3	111.1
60E	6A	General Medical Officer	166.2	40.4	206.6
63A	6C	Dental Officer	50.8	7.1	57.9
31A	7H	Law Enforcement Officer	61.3	7.6	68.9
<u>Army, Warrant Officer</u>					
761A	8B	General Supply Technician	665.4	291.6	957.0
<u>Navy, Enlisted</u>					
AT	100	Aviation Electronics Technician, Third to First Class	245.6	29.0	274.6
AT	100	Aviation Electronics Technician, Chief	66.2	3.3	69.5
RM	201	Radioman, Third to First Class	28.2	28.2	56.4
AC	222	Air Traffic Controller, Chief to Master Chief	19.5	5.3	24.8
PN	500	Personnelmen, Third to Second Class	222.0	1,052.0	1,274.0
PN	500	Personnelmen, Senior Chief to Master Chief	1,770.0	827.0	2,597.0
AD	601	Aviation Machinist's Mate, Third to Second Class	56.7	2.3	59.0
AD	601	Aviation Machinist's Mate, First Class to Chief	725.1	148.9	874.0
BU	710	Builder, Third to Second Class	1,333.0	51.0	1,384.0

TABLE 7 (Continued)

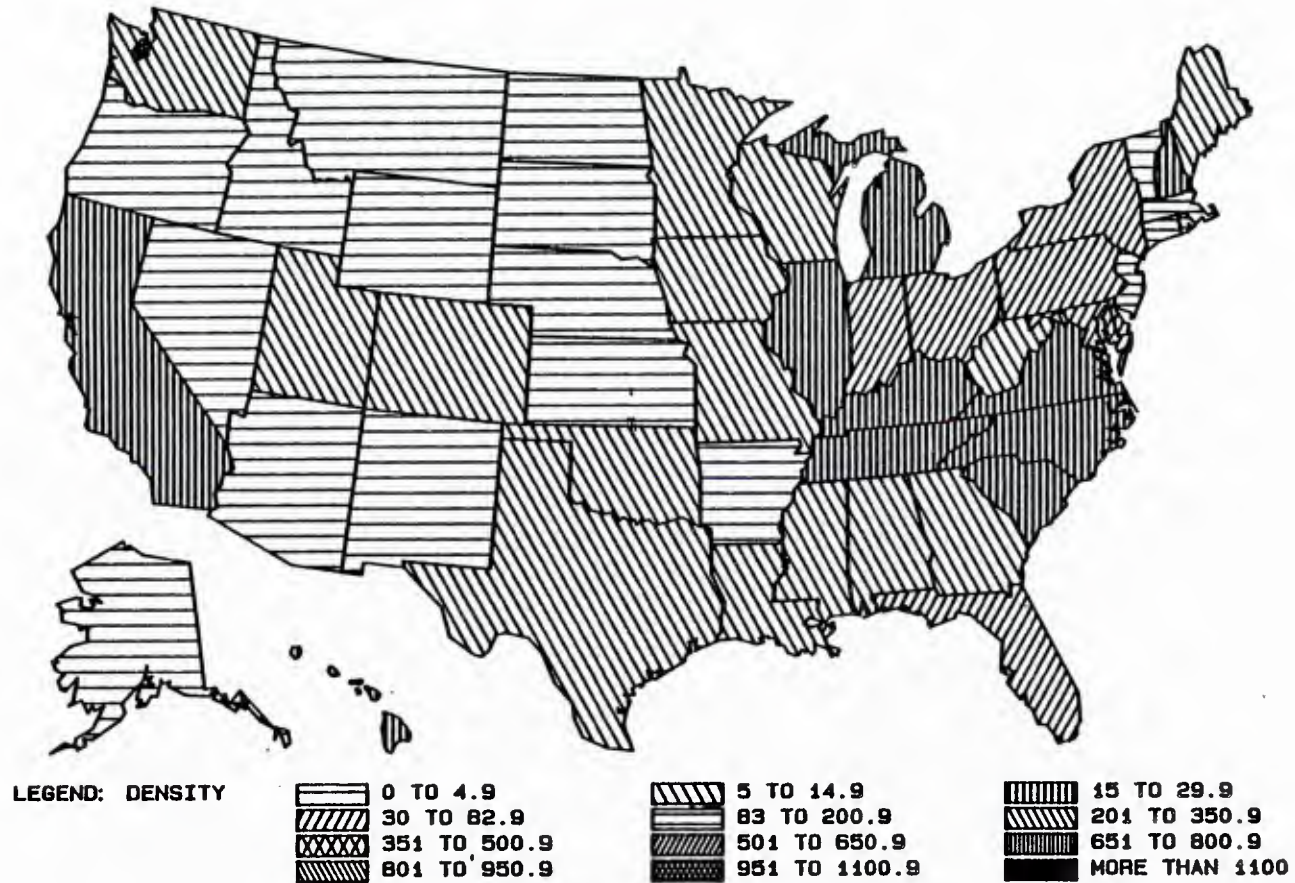
<u>MOS code</u>	<u>DoD code</u>	<u>Title</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
<u>Navy, Officer</u>					
5917	4B	Electronic Equipment Research Officer	171.2	12.6	183.8
8190	4D	Aircraft Intermediate Maintenance Officer, General	1,770.0	827.0	2,597.0
0944	6E	Staff Nurse	40.5	799.1	839.6
9735	7E	Computer Systems Analyst	106.6	37.8	144.4
<u>Air Force, Enlisted</u>					
30554	150	Electronic Computer and Switching Systems Specialist	245.6	29.0	274.6
30574	150	Electronic Computer and Switching System Technician	66.2	3.3	69.5
29353	201	Ground Radio Operator	28.2	28.2	56.4
60251	553	Freight Traffic Specialist	270.5	86.5	357.0
54252	662	Electrical Power Production Specialists	323.1	14.1	337.2
<u>Air Force, Officer</u>					
1045	2B	Pilot, Transport	39.1	1.0	40.1
1535	2D	Navigator, General	39.1	1.0	40.1
5516	4A	Civil Engineering Staff Officer	121.5	8.2	129.7
3016	4C	Communications-Electronics Systems Staff Officer	1,770.0	827.0	2,597.0
9346	6A	Family Physician	166.2	40.5	206.7
<u>Marine Corps, Enlisted</u>					
4641	400	Photographer	48.9	21.6	70.5
0151	510	Administrative Clerk	216.1	1,005.0	1,221.0
4034	531	Computer Operator	177.9	521.0	698.9
<u>Marine Corps, Officer</u>					
1302	2E	Engineer Officer (I)	1,770.0	827.0	2,597.0
2502	4C	Communications Officer (I, III)	74.6	50.2	124.8
5803	7H	Military Police (I)	39.2	6.6	45.8

a. Within branch and community, the jobs are sorted by the DoD occupational code.



**FIG. 9: AUDIO-VISUAL EQUIPMENT REPAIRER
(ARMY, ENLISTED, SERVICE OCC CODE 41E)**

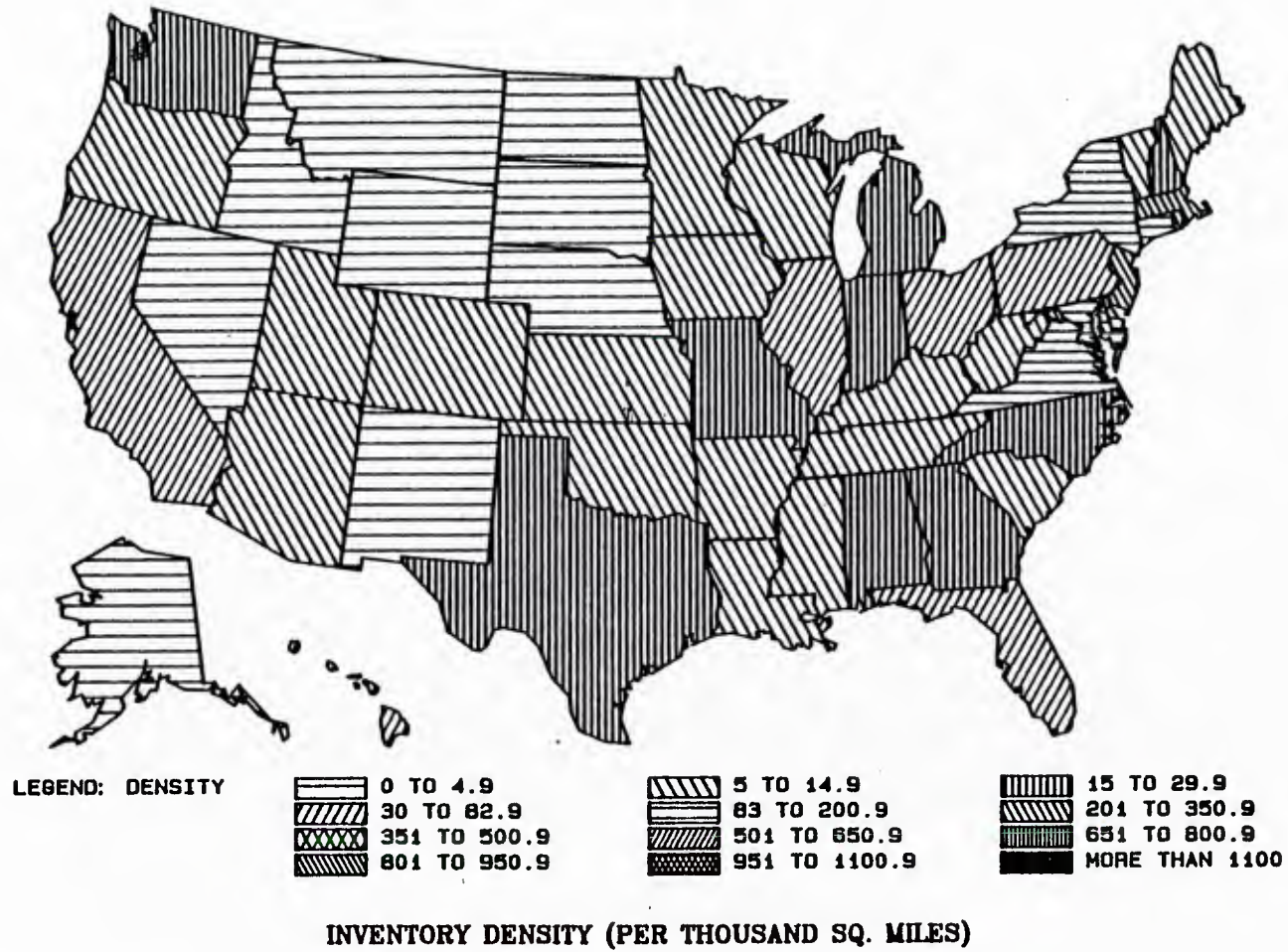
U.S.



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 10: AIRCRAFT ELECTRICIAN (ARMY, ENLISTED, SERVICE OCC CODE 68F)

U.S.



U.S.

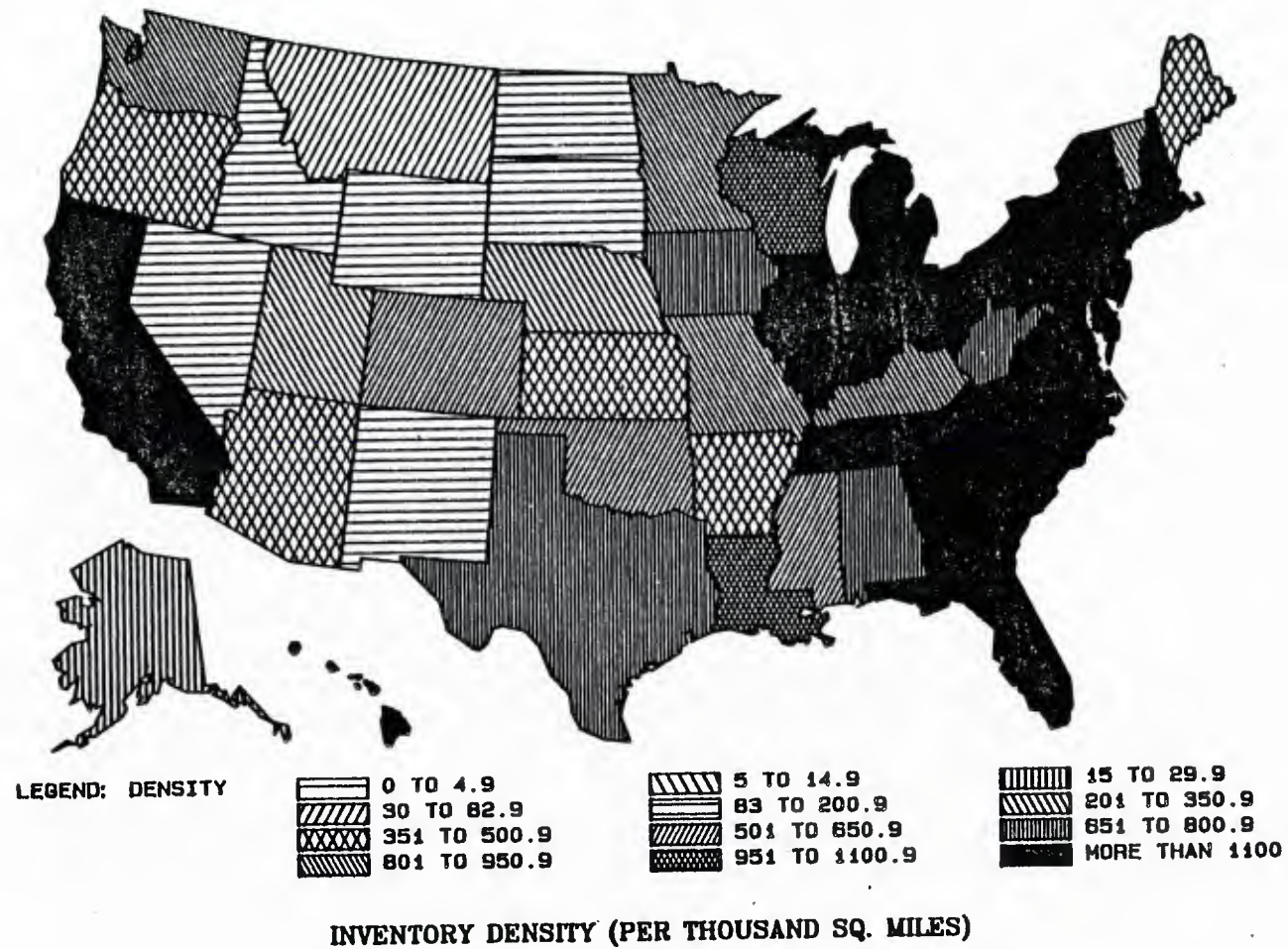
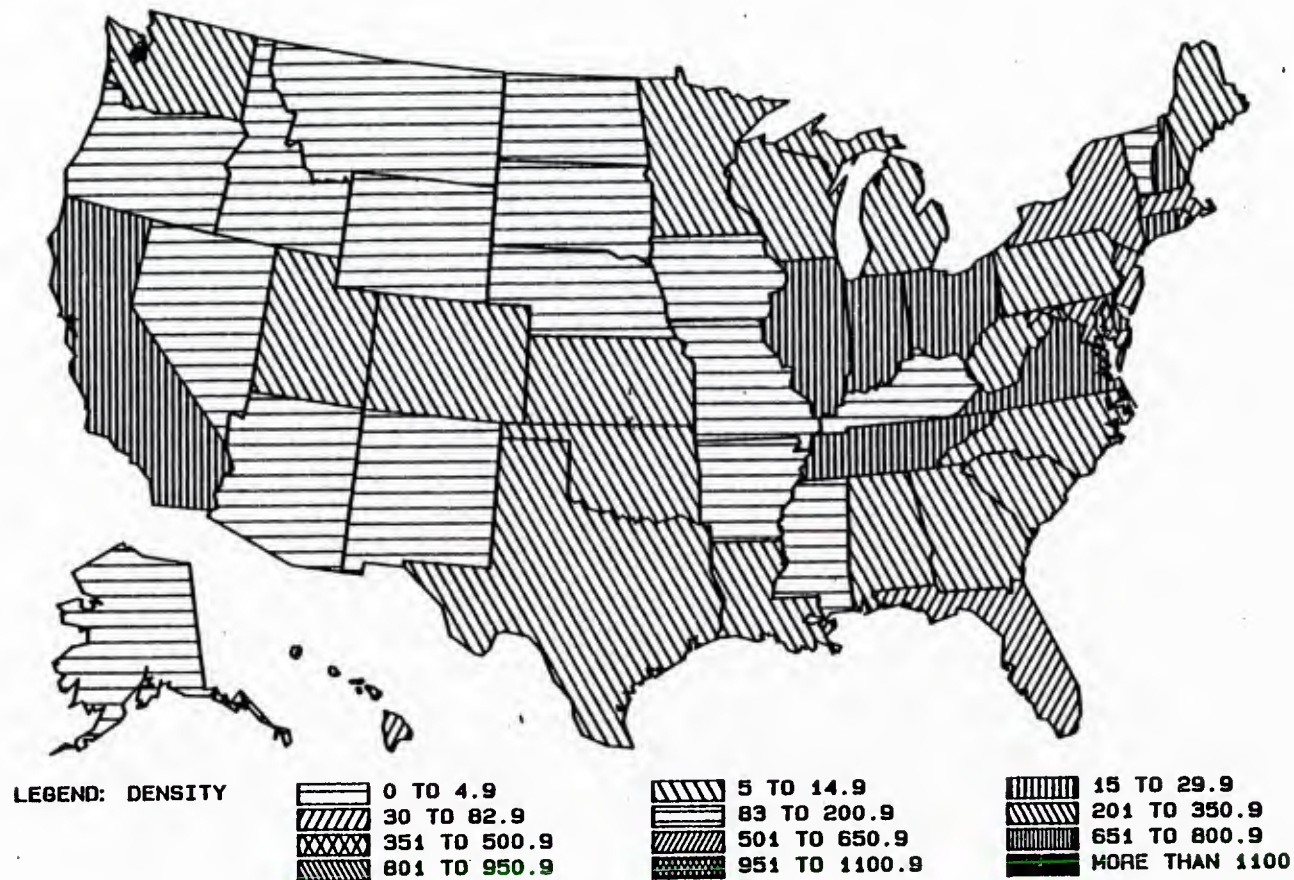


FIG. 12: FLIGHT OPERATORS COORDINATOR (ARMY, ENLISTED, SERVICE OCC CODE 71P)

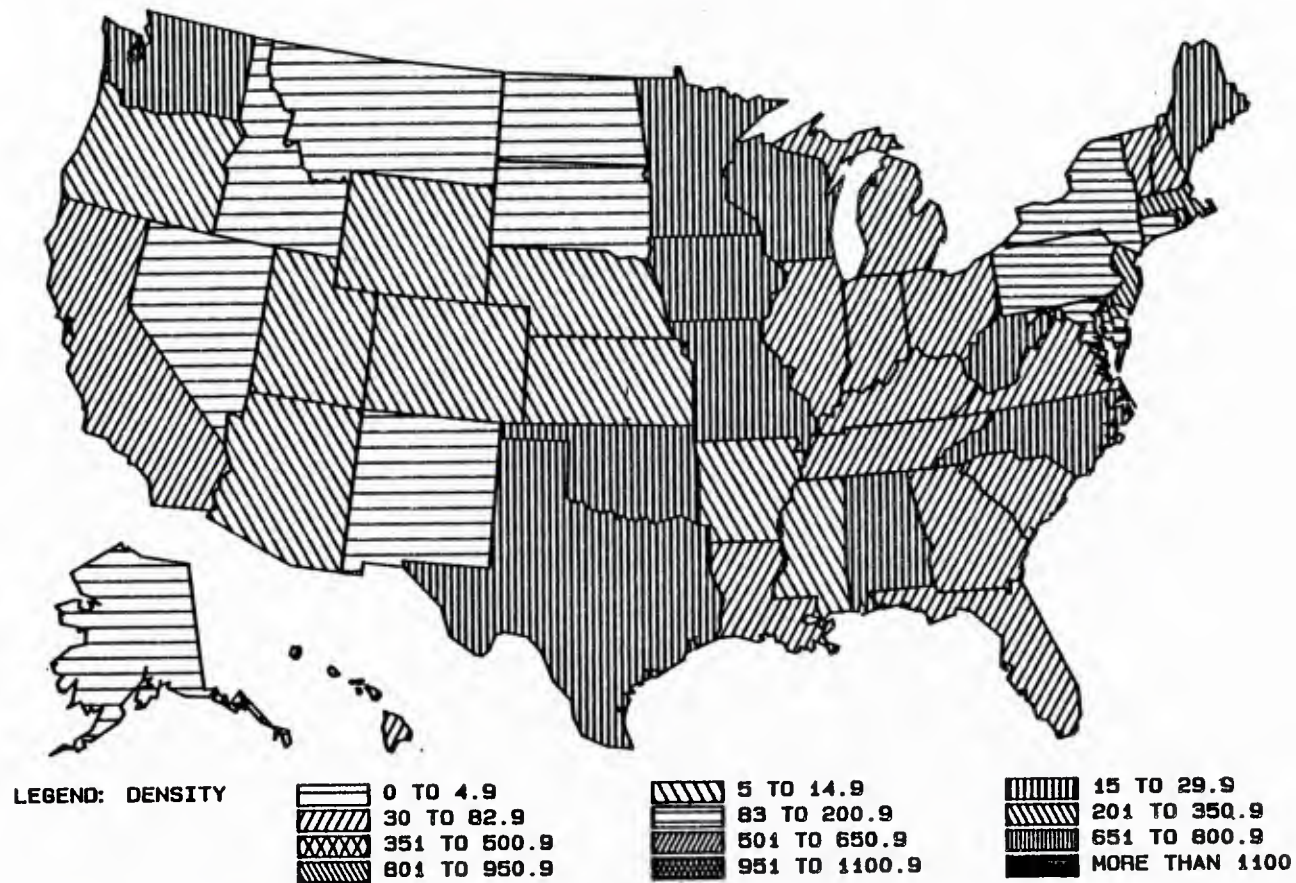
U.S.



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 13: AIR TRAFFIC CONTROL TOWER OPERATOR
(ARMY, ENLISTED, SERVICE OCC CODE 93H)

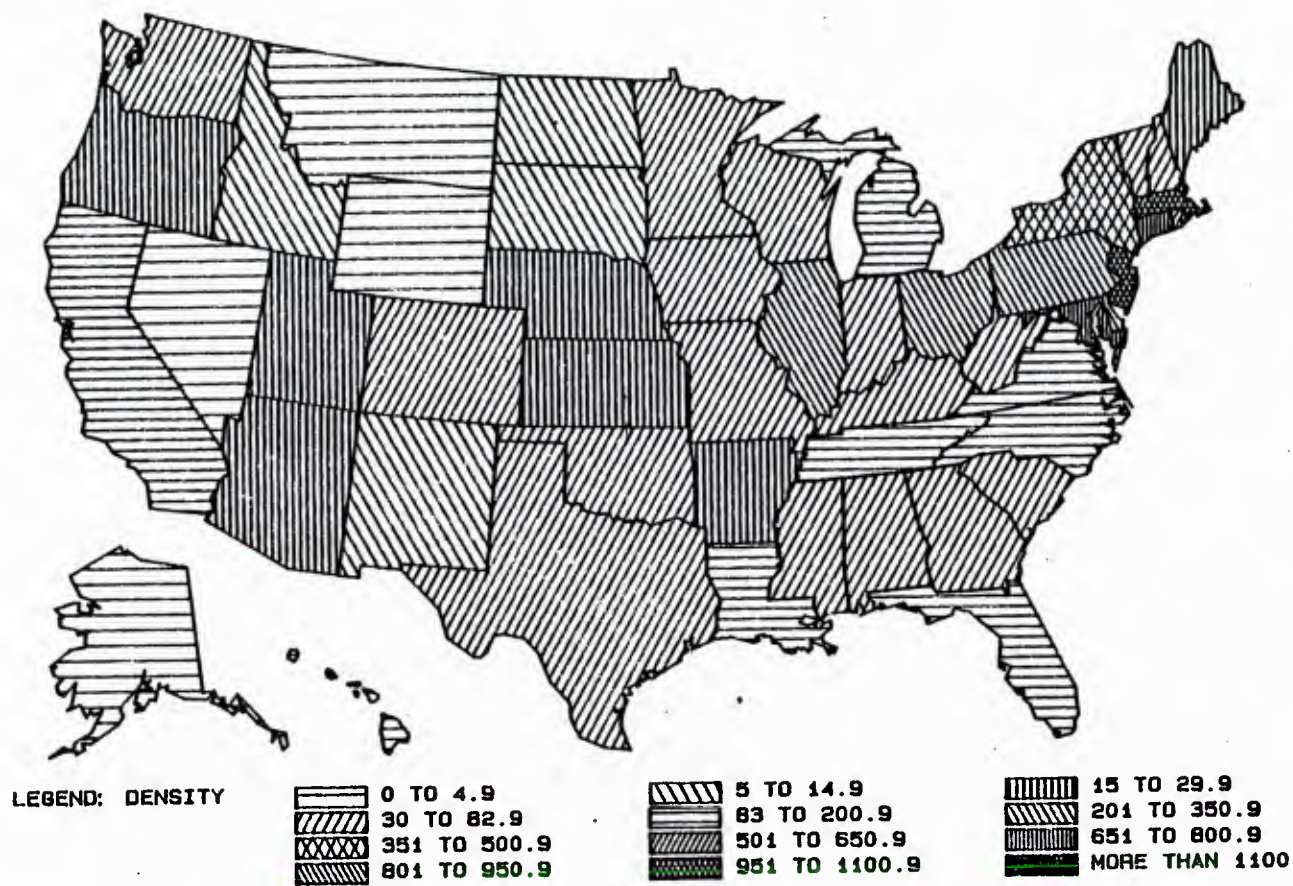
U.S.



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 14: DATA PROCESSING SYSTEMS REPAIR TECHNICIAN
(ARMY, WARRANT OFFICER, SERVICE OCC CODE 278A)

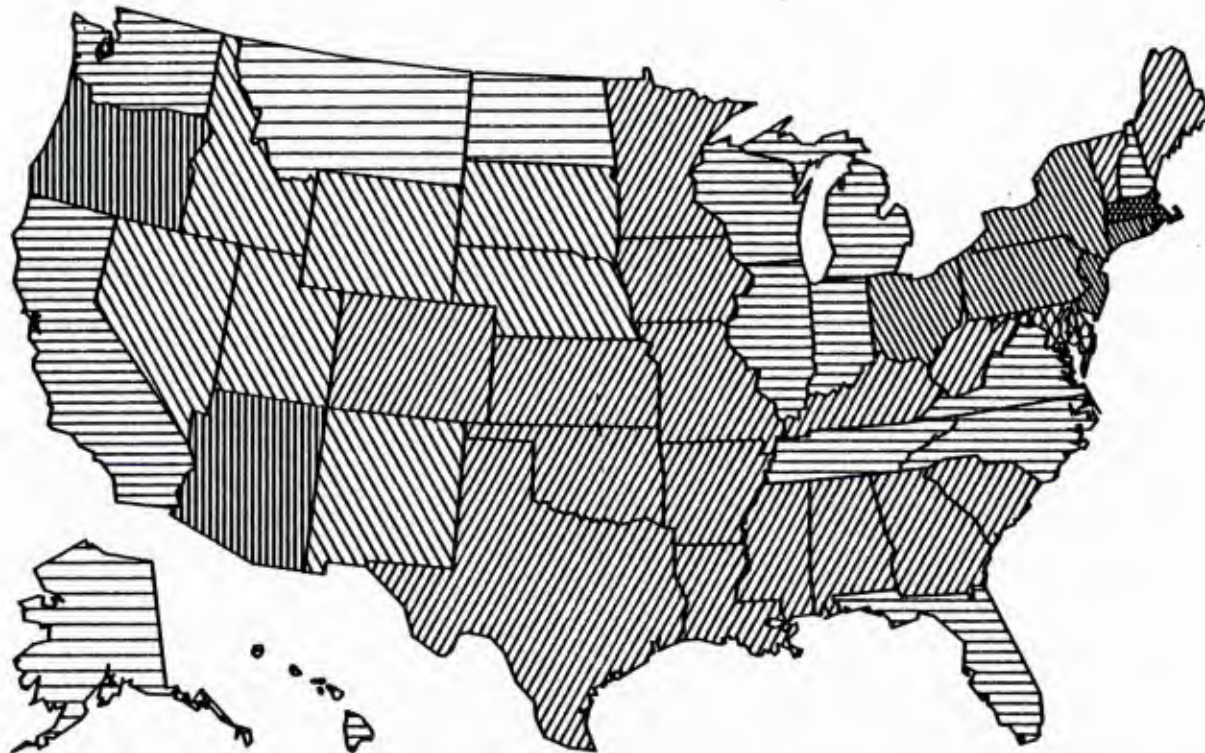
U.S.



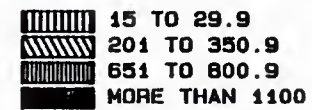
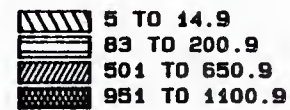
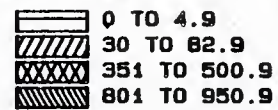
INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 15: GENERAL MEDICINE OFFICER (ARMY, COMMISSIONED OFFICER, SERVICE OCC CODE 60E)

U.S.



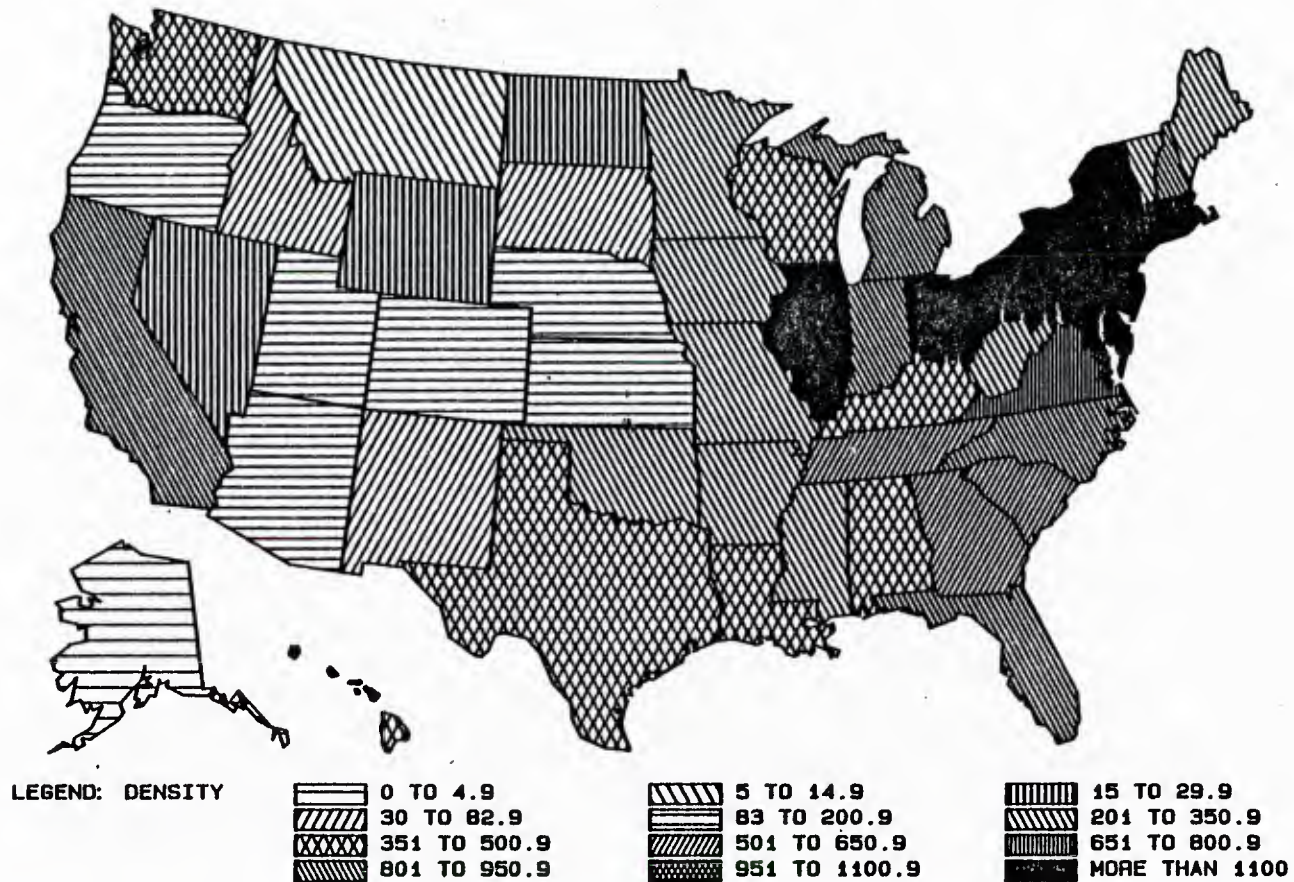
LEGEND: DENSITY



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 16: SANITARY ENGINEER (ARMY, COMMISSIONED OFFICER, SERVICE OCC CODE 68P)

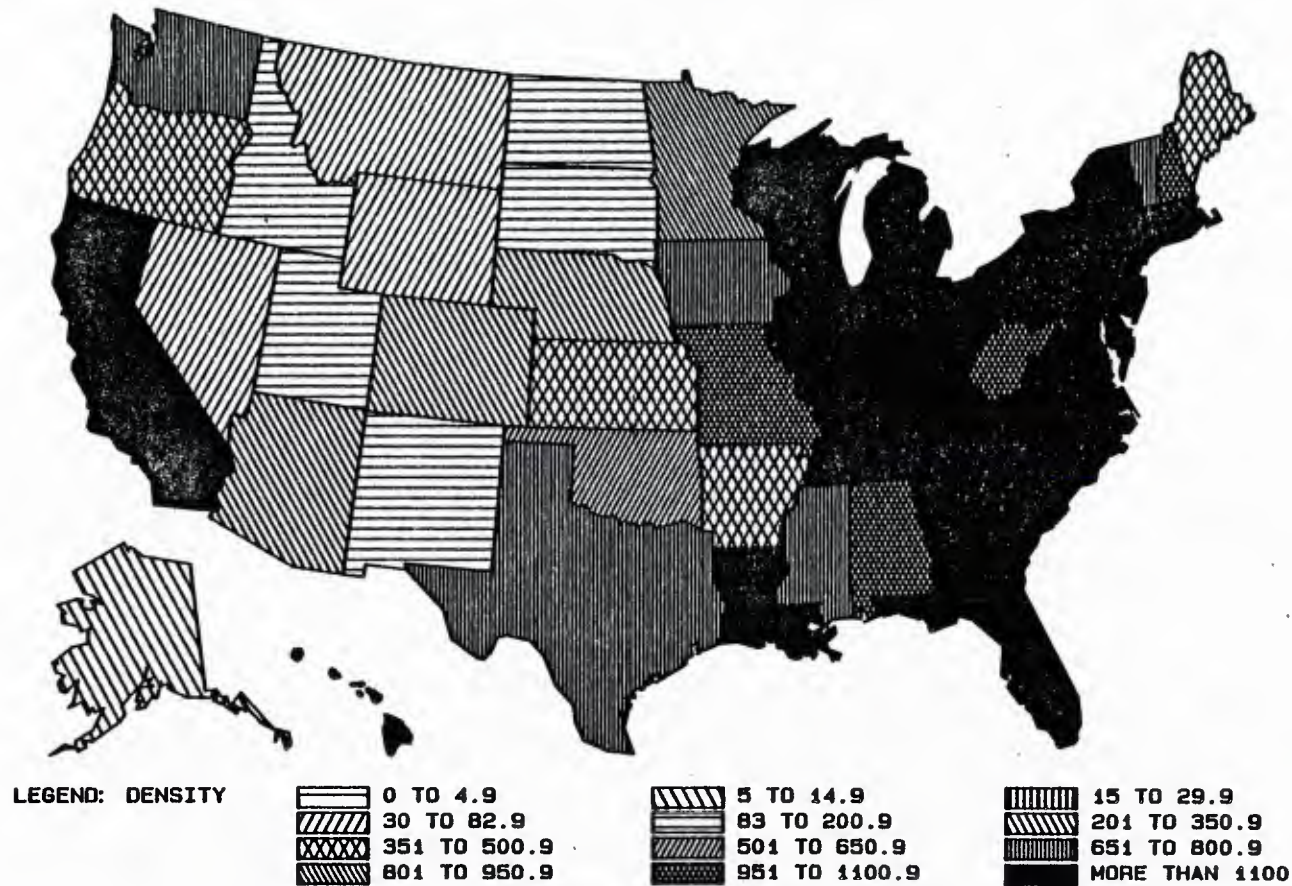
U.S.



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 17: EQUIPMENT OPERATOR, CHIEF (NAVY, ENLISTED, SERVICE OCC CODE EO)

U.S.



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 18: HOSPITAL CORPSMAN, THIRD TO FIRST CLASS
(NAVY, ENLISTED, SERVICE OCC CODE HM)

U.S.

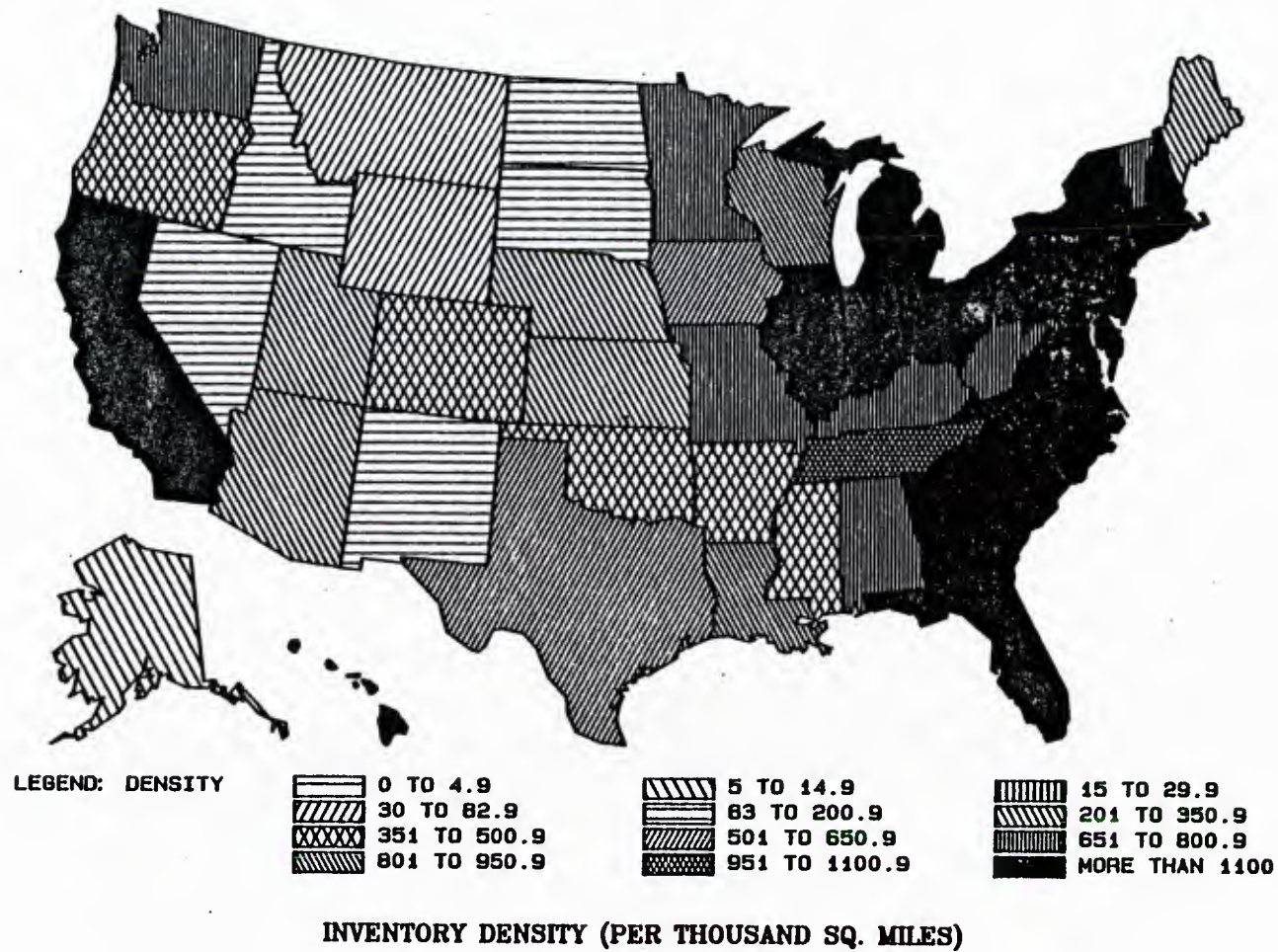


FIG. 19: RADIOMAN, CHIEF OR MASTER CHIEF (NAVY, ENLISTED, SERVICE OCC CODE RM)

U.S.

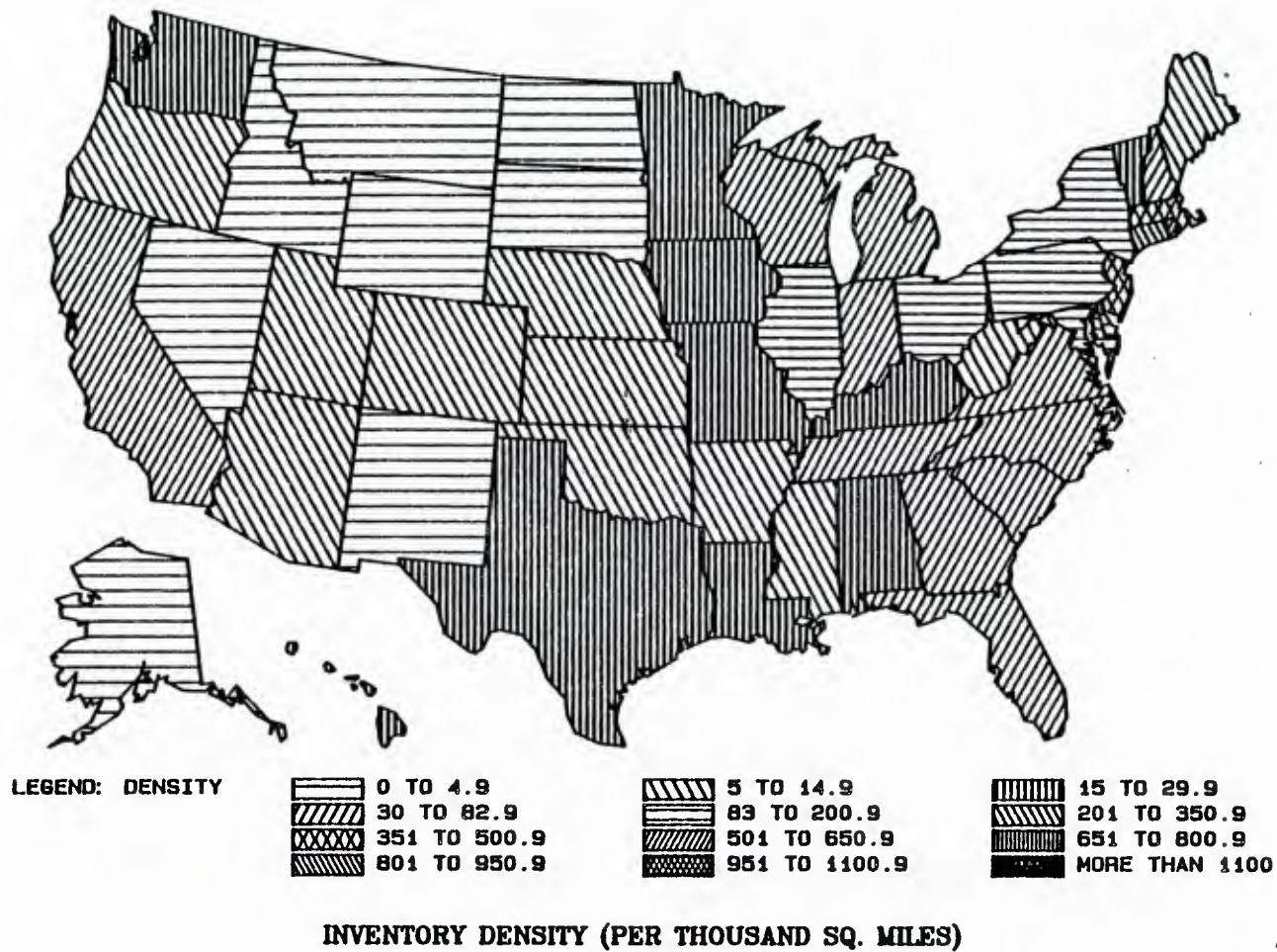
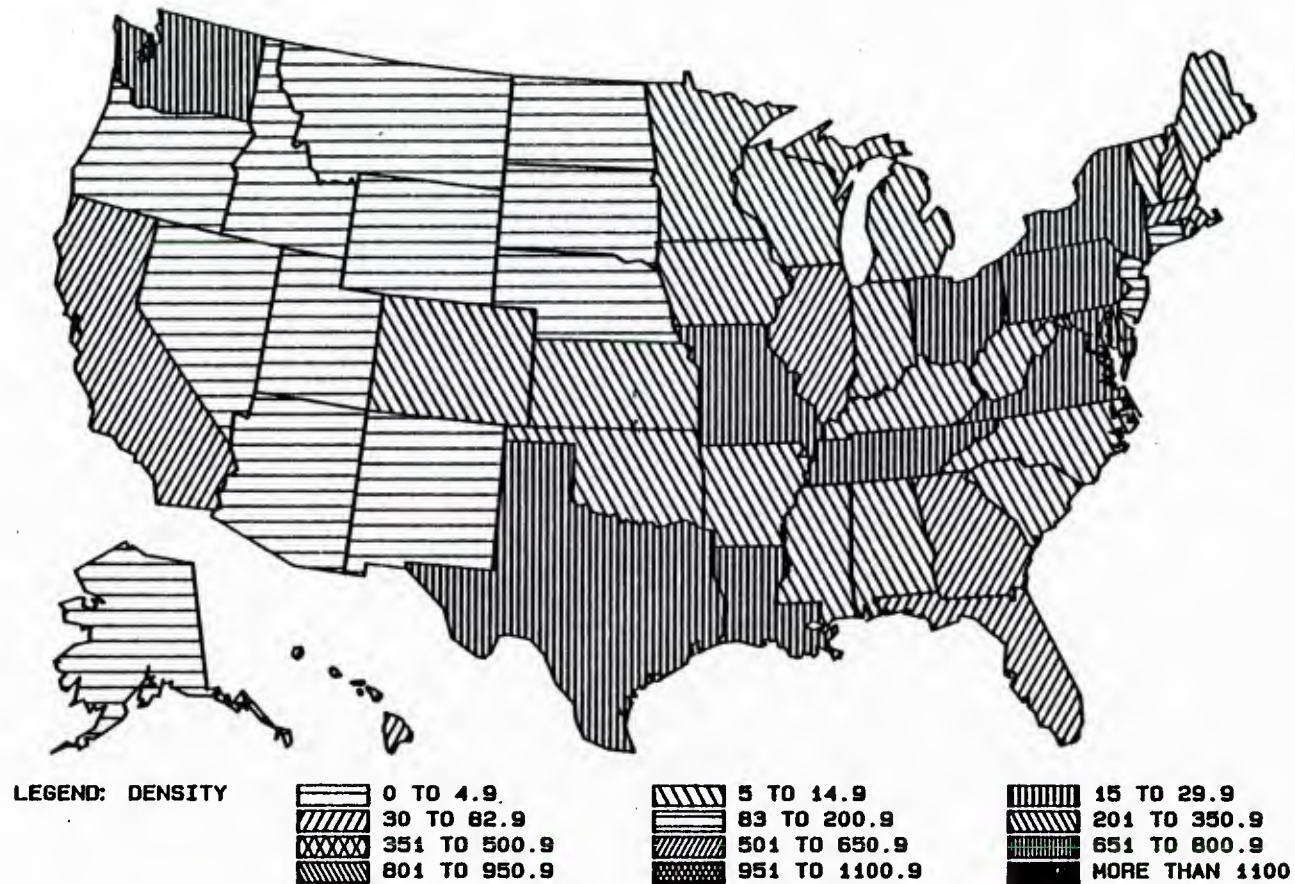


FIG. 20: STOREKEEPER, FIRST CLASS TO CHIEF (NAVY, ENLISTED, SERVICE OCC CODE SK)

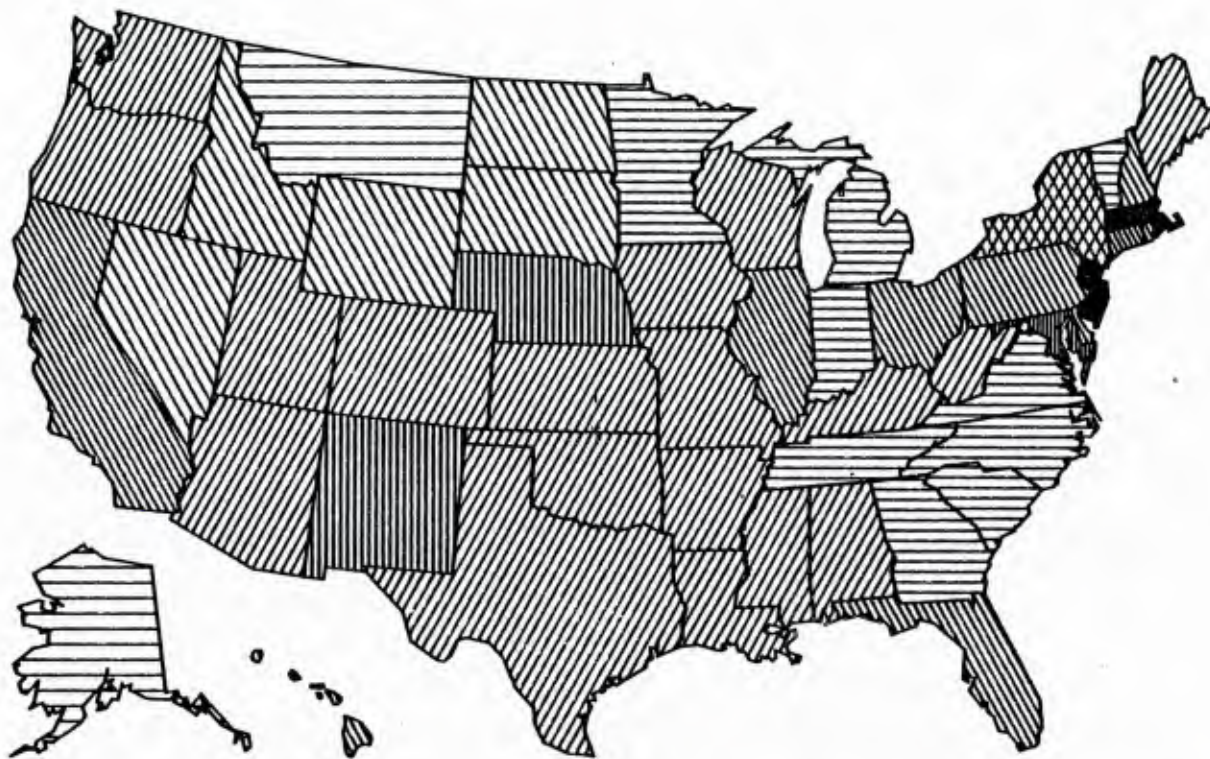
U.S.



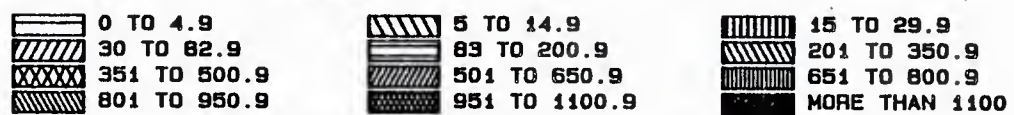
INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 21: TEST PILOT (NAVY, OFFICER, SERVICE OCC CODE 8588)

U.S.



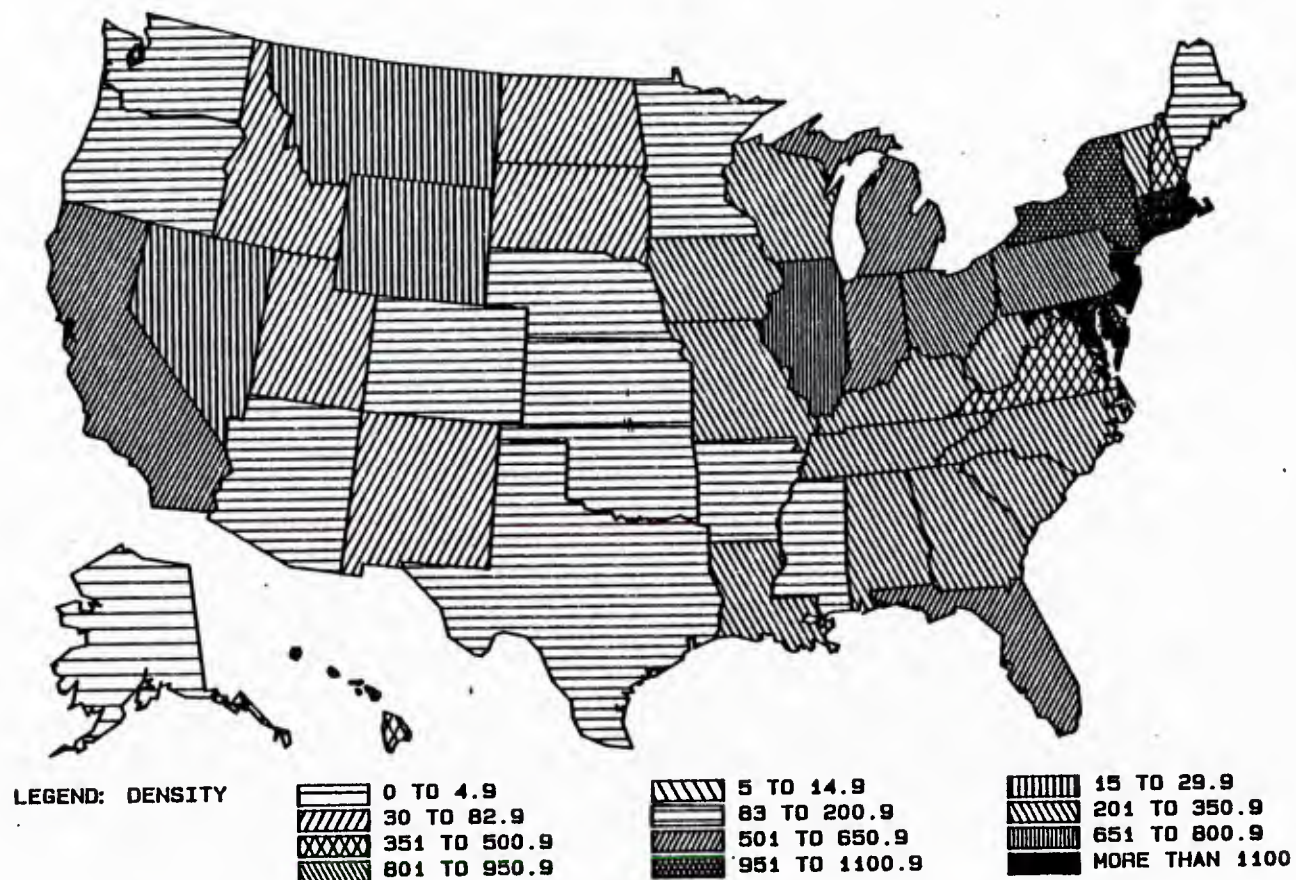
LEGEND: DENSITY



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 22: AIR TRAFFIC CONTROL RADAR SPECIALIST
(AIR FORCE, ENLISTED, SERVICE OCC CODE 30351)

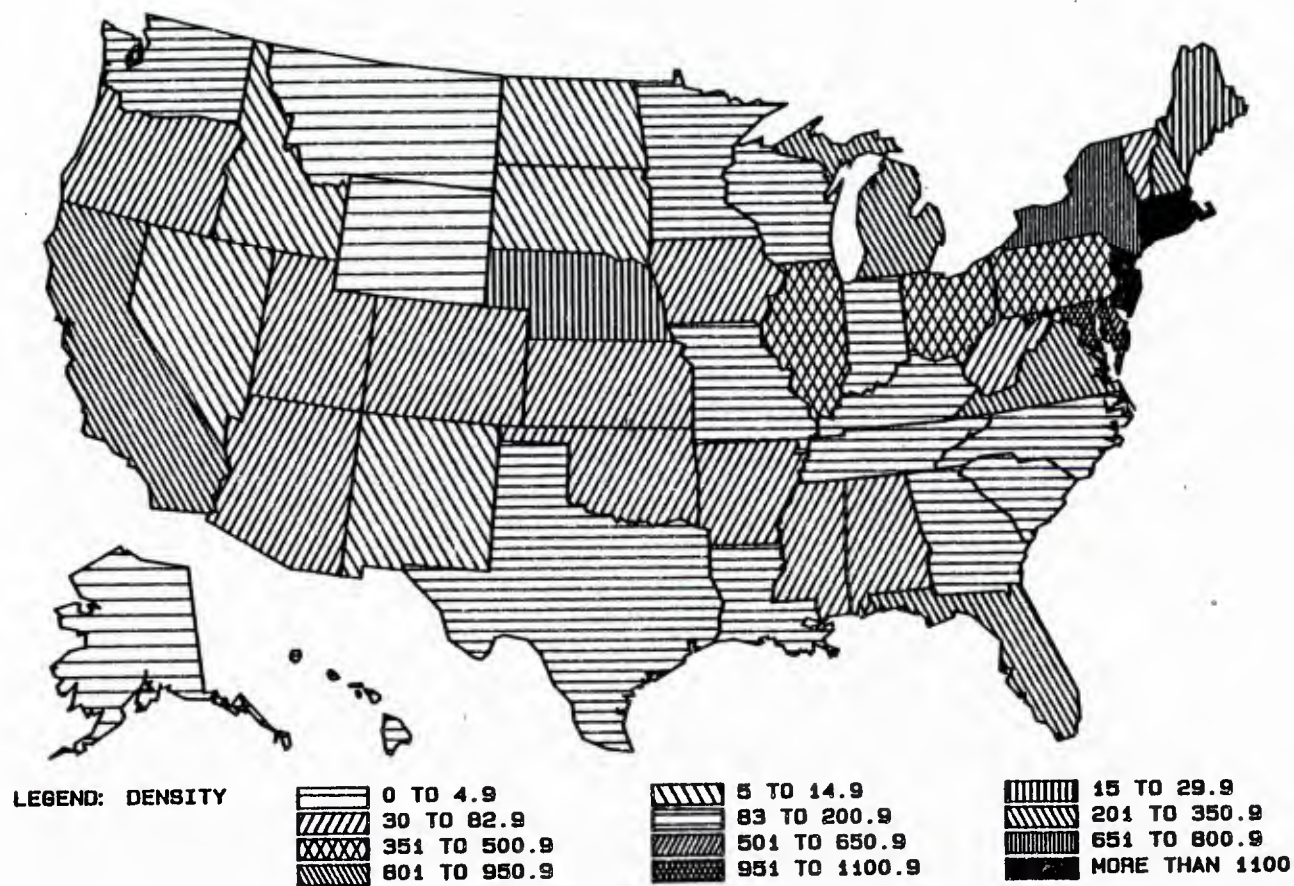
U.S.



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 23: GENERAL PURPOSE VEHICLE MECHANIC
(AIR FORCE, ENLISTED, SERVICE OCC CODE 47252)

U.S.



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 24: COMPUTER PROGRAMMER SPECIALIST
(AIR FORCE, ENLISTED, SERVICE OCC CODE 51151)

U.S.

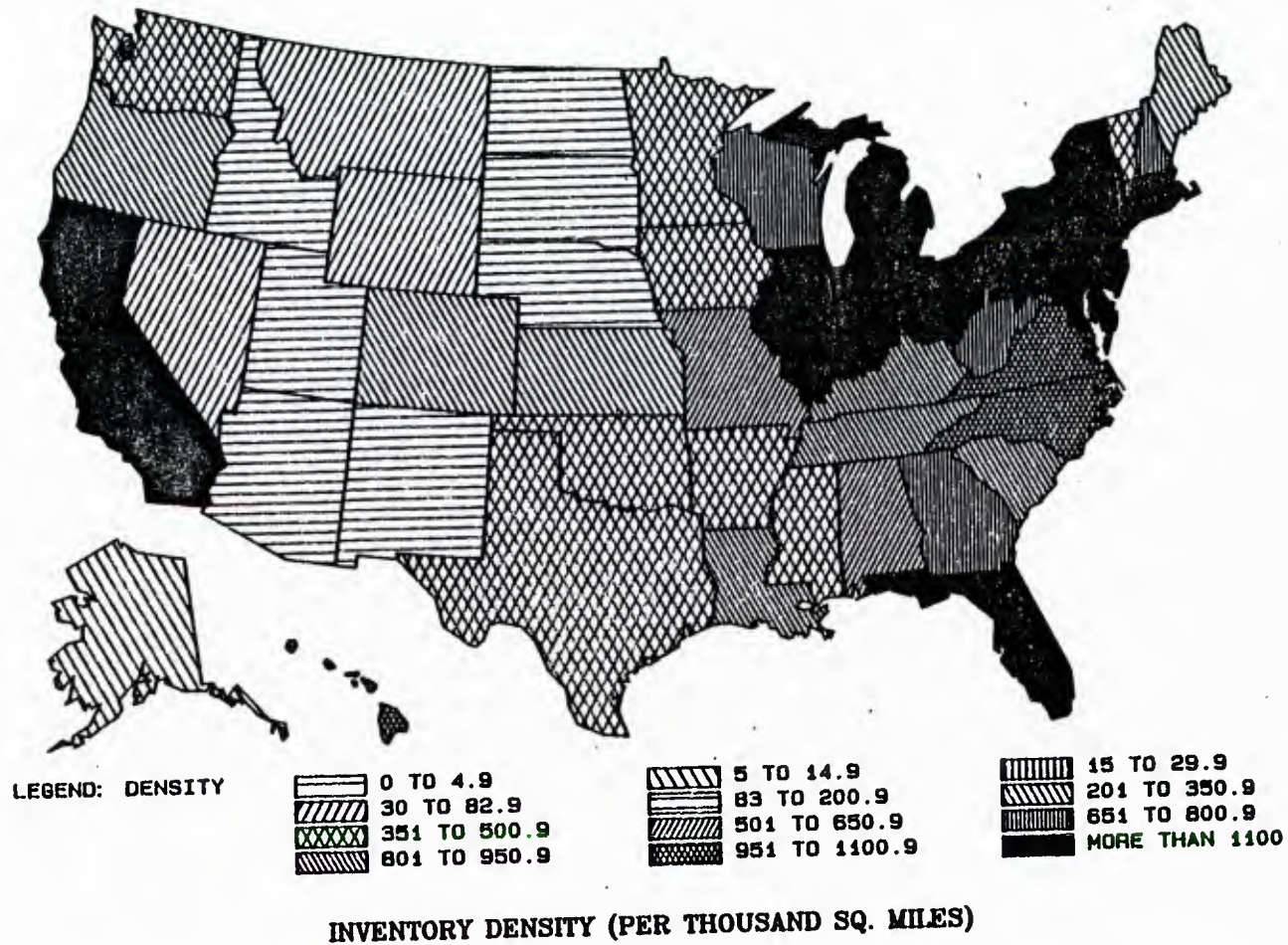
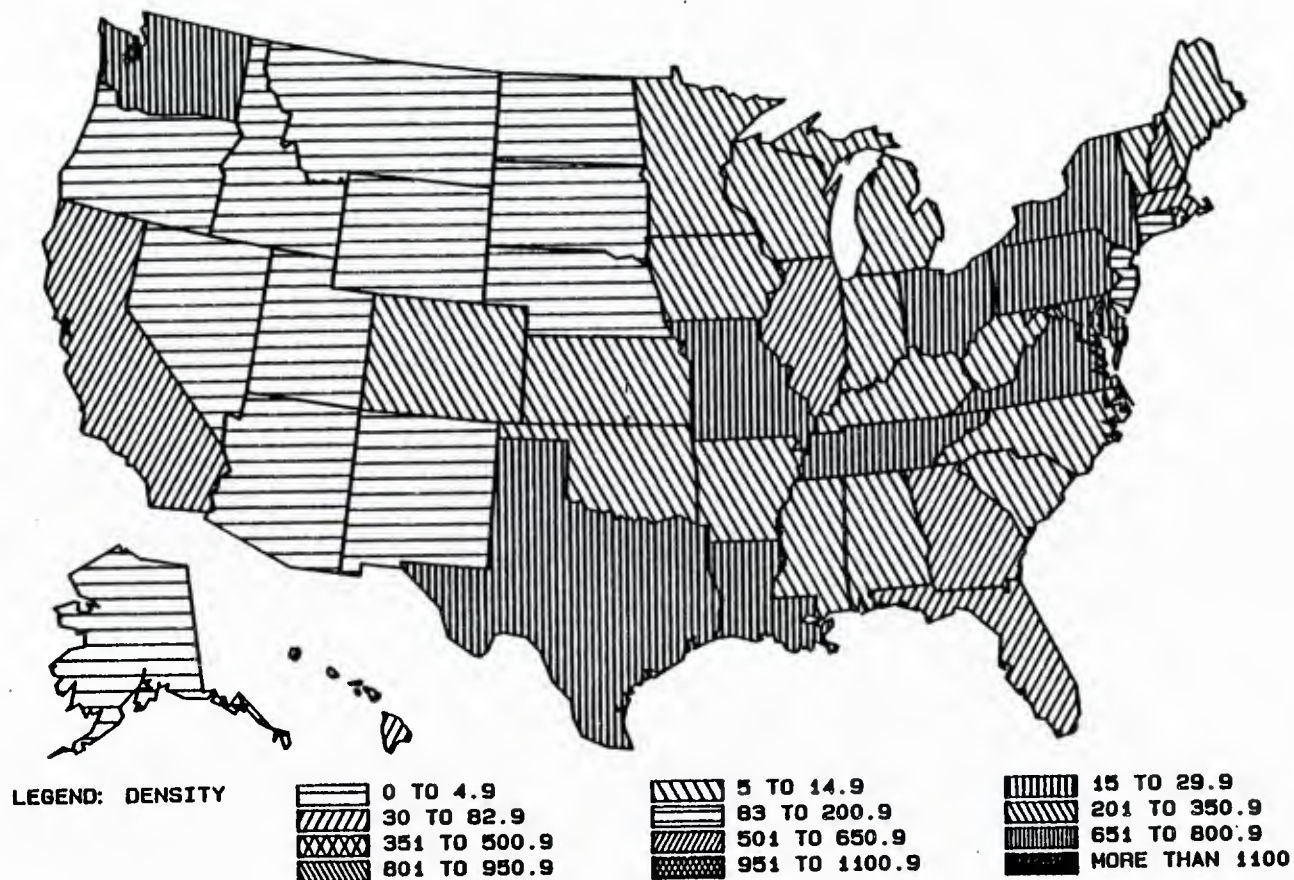


FIG. 25: VEHICLE OPERATOR/DISPATCHER (AIR FORCE, ENLISTED, SERVICE OCC CODE 60350)

U.S.



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 26: NAVIGATOR, GENERAL (AIR FORCE, OFFICER, SERVICE OCC CODE 1535)

U.S.

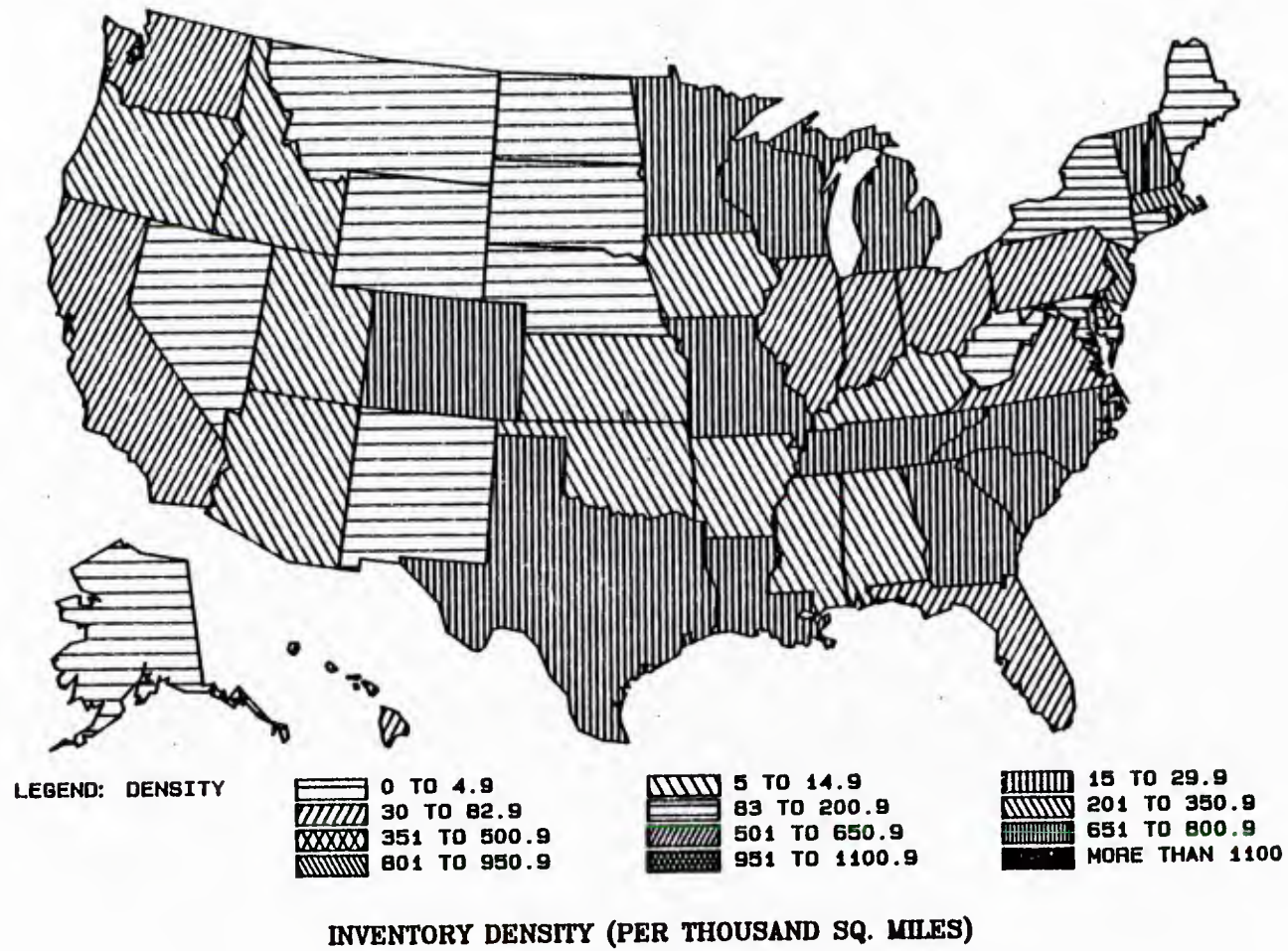


FIG. 27: CIVIL ENGINEERING OFFICER (AIR FORCE, OFFICER, SERVICE OCC CODE 5525)

U.S.

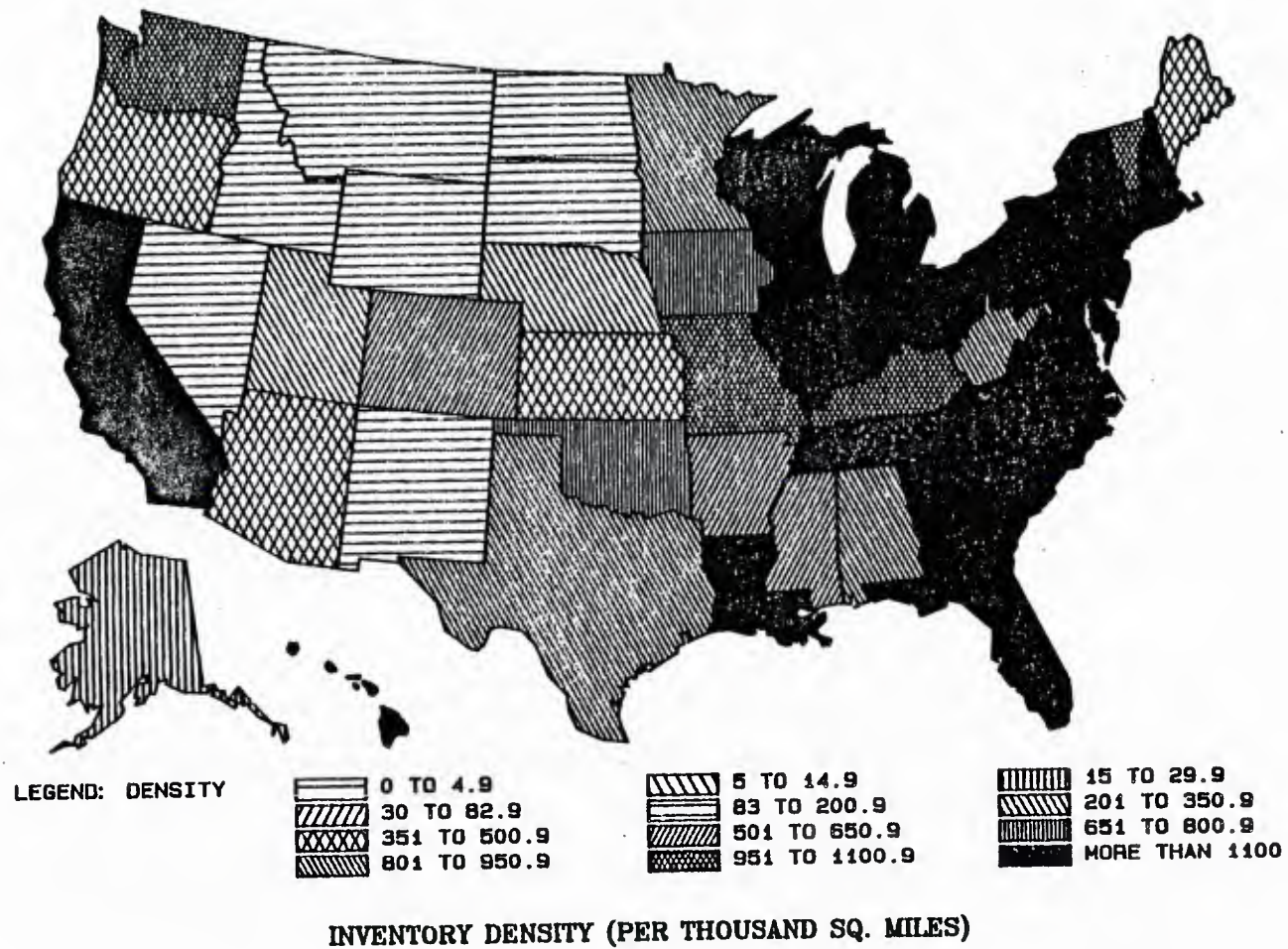
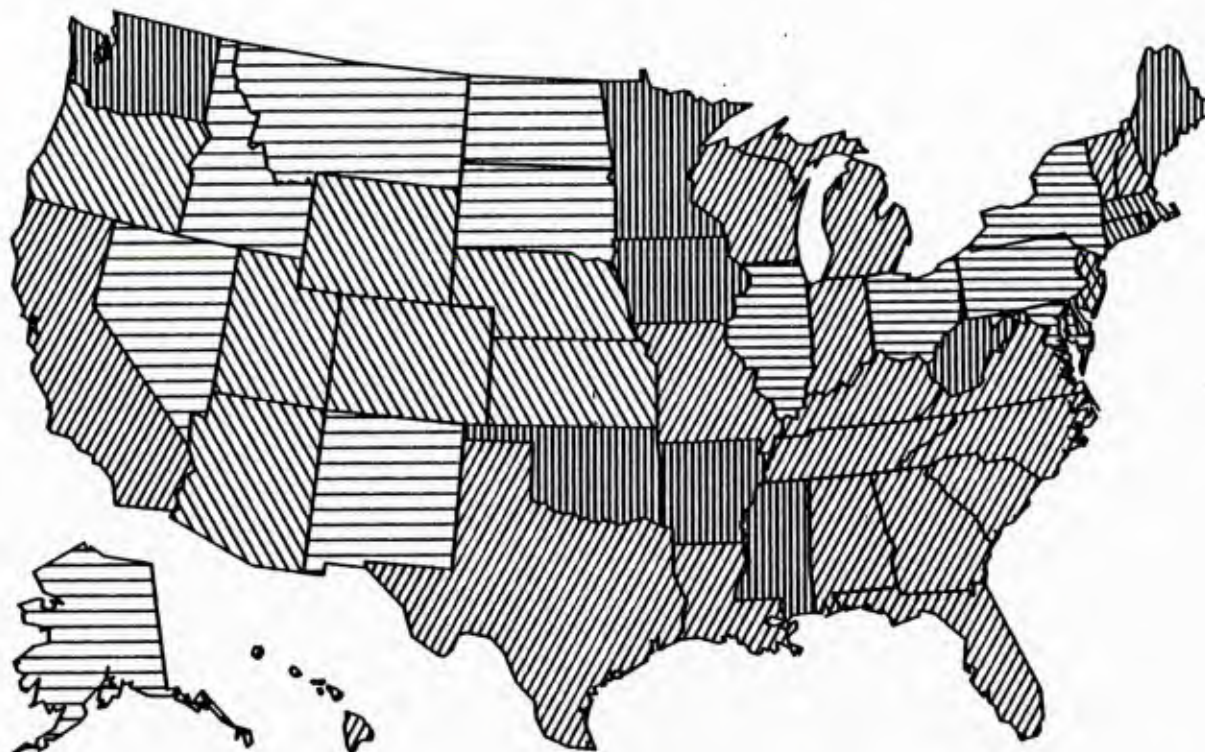
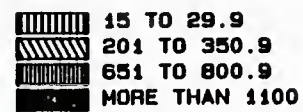
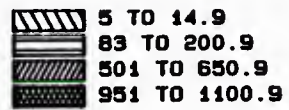
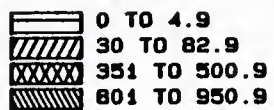


FIG. 28: SUPPLY OPERATIONS OFFICER (AIR FORCE, OFFICER, SERVICE OCC CODE 6424)

U.S.



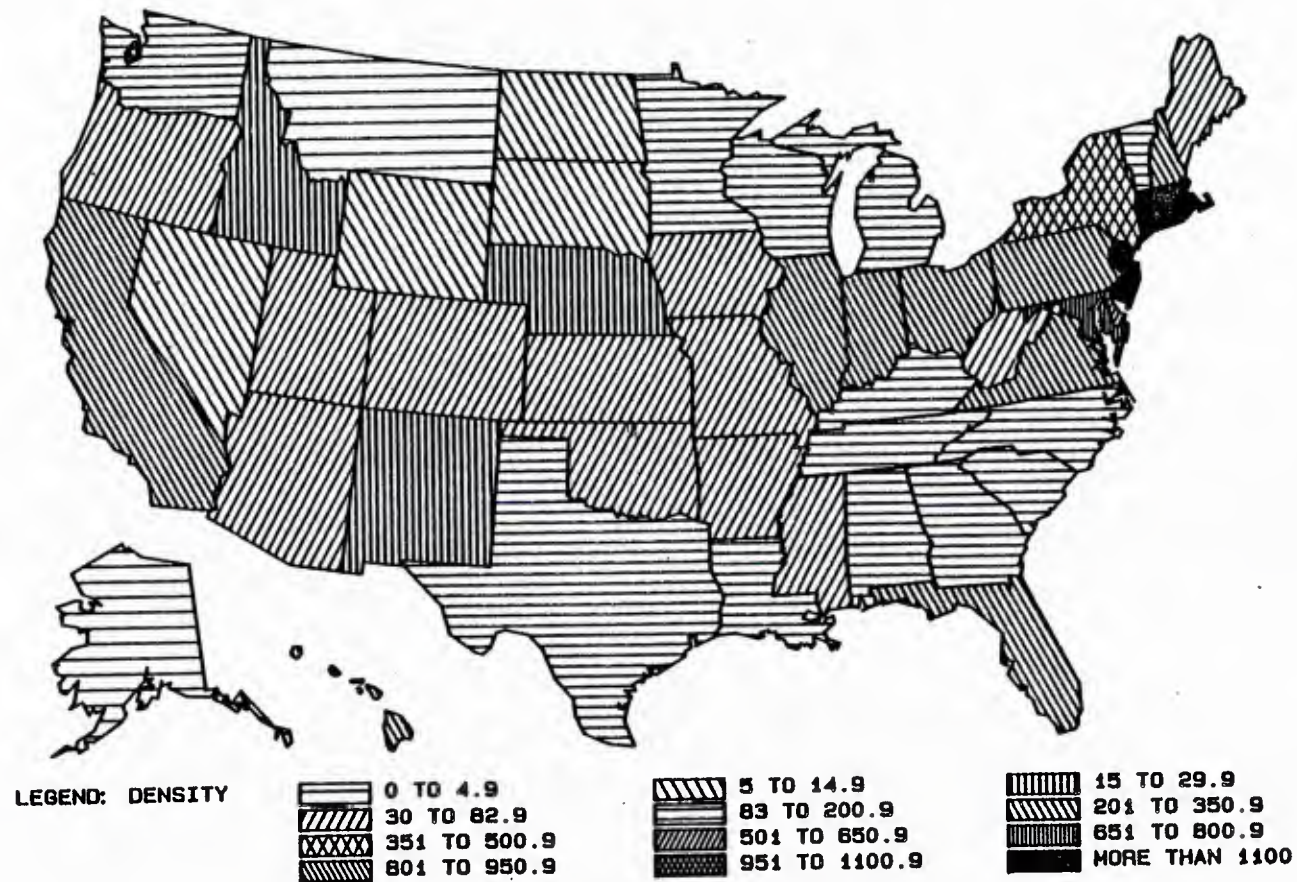
LEGEND: DENSITY



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 29: OFFICE MACHINE REPAIR SPECIALIST (MARINE CORPS, ENLISTED, SERVICE OCC CODE 1182)

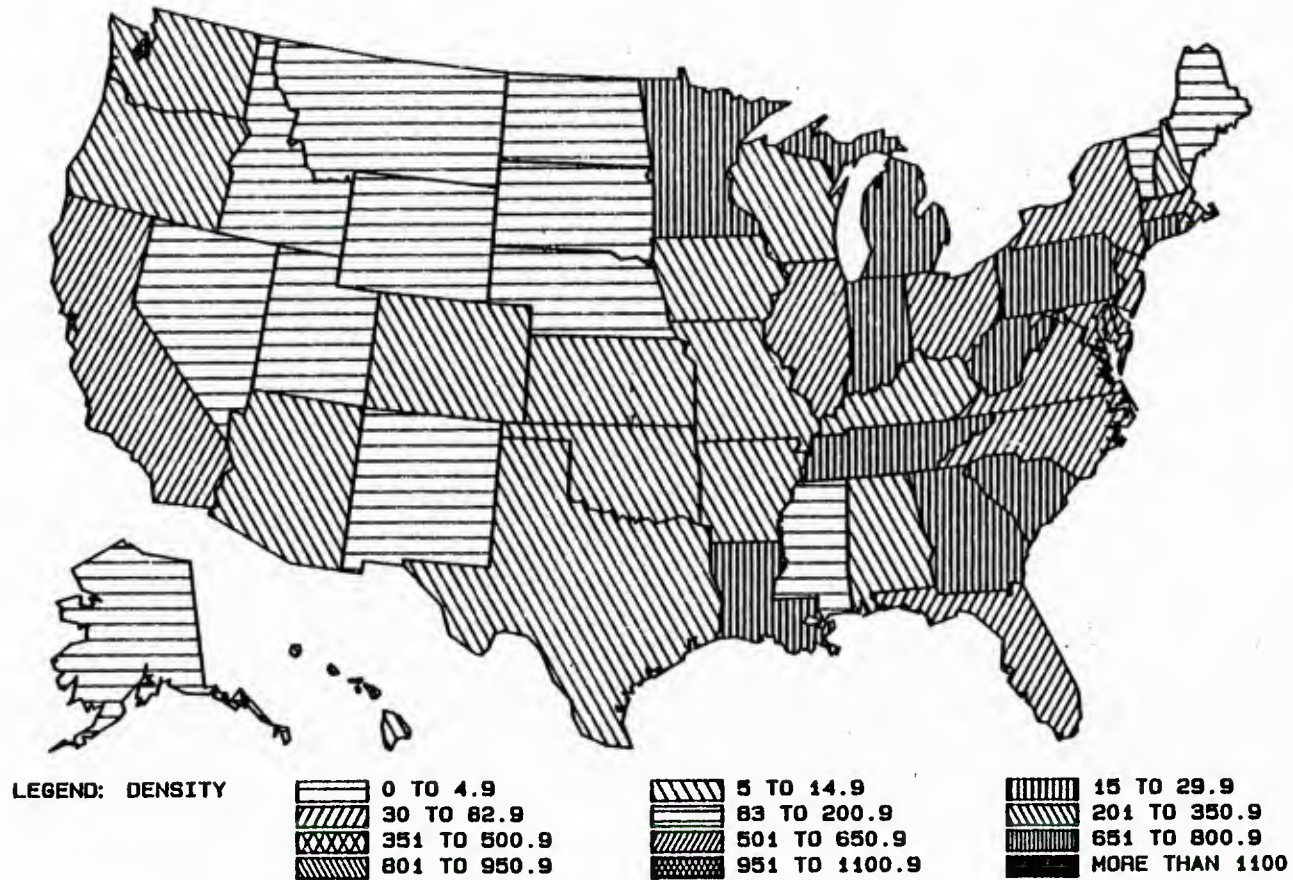
U.S.



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 30: RADIO TECHNICIAN (MARINE CORPS, ENLISTED, SERVICE OCC CODE 2861)

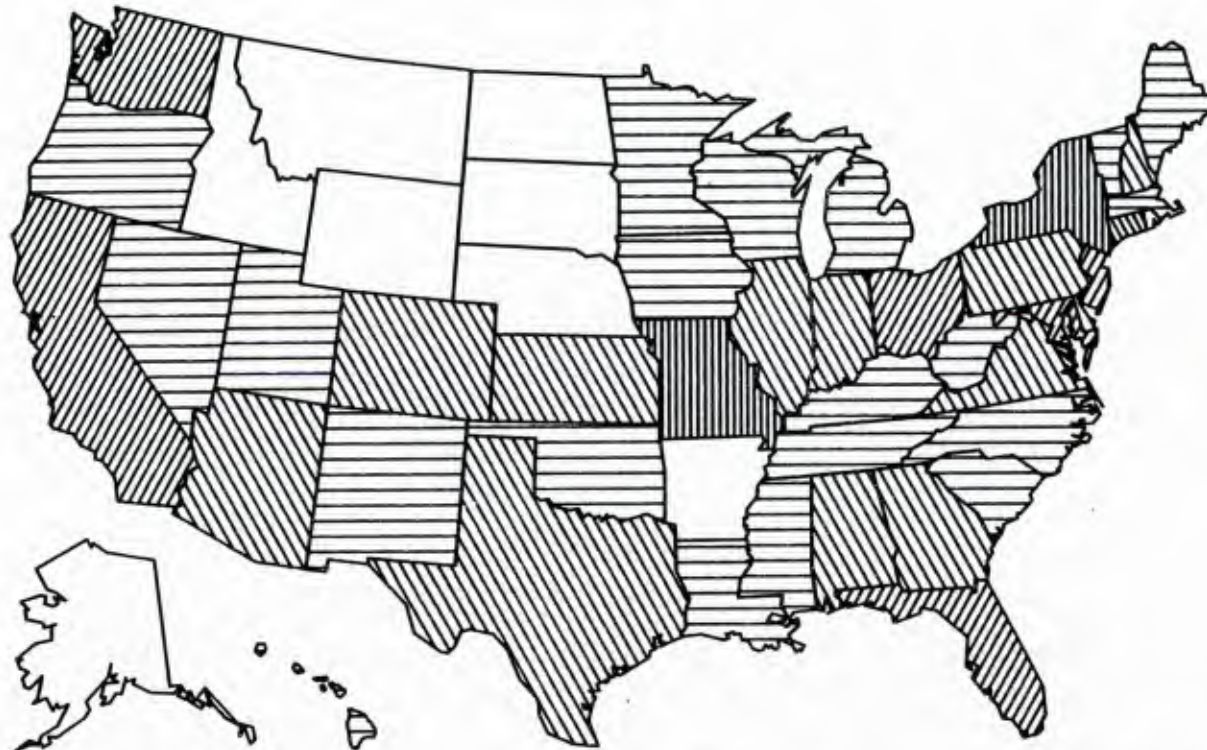
U.S.



INVENTORY DENSITY (PER THOUSAND SQ. MILES)

FIG. 31: MILITARY POLICE OFFICER (I) (MARINE CORPS, OFFICER,
SERVICE OCC CODE 5803)

U.S.



LEGEND: DENSITY

0 TO 4.9
30 TO 82.9
351 TO 500.9
801 TO 950.9

5 TO 14.9
83 TO 200.9
501 TO 650.9
951 TO 1100.9

15 TO 29.9
201 TO 350.9
651 TO 800.9
MORE THAN 1100

FIG. 32: AERONAUTICAL ENGINEER (MARINE CORPS OFFICER,
SERVICE OCC CODE 6005)

TABLE 8

**CIVILIAN MATCHES TO AN ARMY ENLISTED OCCUPATION,
METALWORKER: AN ILLUSTRATION OF HOW THE
CIVILIAN INVENTORY MIGHT BE ORGANIZED**

<u>By age and sex</u>	<u>Civilian matches</u>
Males	
16-19 years	154,200
20-24 years	414,700
25-29 years	347,800
30-34 years	270,600
35-39 years	201,700
Total males (under 40 years)	1,389,000
Females	
16-19 years	7,760
20-24 years	19,800
25-29 years	16,400
30-34 years	11,920
35-39 years	9,620
Total females (under 40 years)	65,500
Total, males and females under 40 years	1,454,500
<u>By education level and sex</u>	
Males	
Not high school graduate	427,500
High school graduate	825,900
Two years college	107,900
Four or more years college	27,700
Total males (under 40 years)	1,389,000
Females	
Not high school graduate	24,000
High school graduate	36,700
Two years college	3,300
Four or more years college	1,500
Total females (under 40 years)	65,500

THE QUESTION OF MOBILIZATION SKILL SHORTAGES

As detailed in the last section, the military/civilian crosswalk, combined with the matrix of civilians by their occupations and other characteristics, allows the size of the civilian pool for each military job to be determined. As noted above, the software allows these "mobilization pools" to be specified as broadly—or as narrowly—as the user desires: one can ask for all civilians whose occupations crosswalk to the desired military job or for only a subset of such civilians.

However, given the way we develop military forces, another key use of the crosswalk is that of estimating how many "units" of appropriately skilled civilians could be mobilized to meet military needs under various scenarios. For example, the crosswalk might show that civilian clerical personnel could be mobilized to complete 20 Army divisions, but the paucity of airplane mechanics would restrict the mobilization to 8 full divisions. Since the Selected Reserve generally mirrors the occupational specialties of the Active Forces, such estimates from the model might lead to reexamination of the efficiency of this manpower stockpiling strategy.

However, a problem arises for model users who want to examine possible mobilization bottlenecks—that is, skill shortages. Many civilians have jobs that crosswalk to several military specialties. Incumbents of these jobs show up in the "mobilization pool" repeatedly, once for every military specialty to which their civilian job is matched.¹ Thus, to identify where the military might encounter real bottlenecks if mobilization occurs, the user must do two things: (1) avoid multiple counting of civilian personnel, and (2) ensure that the allocation within the pool is as efficient as possible—that is, that individuals are counted where their skills are most scarce.

The first point needs little discussion. However, the second—an efficient allocation of civilians from several jobs among competing MOSs—is not a simple task. The basic requirement is a list of military mobilization demands

1. In the example of the interactive software program discussed earlier, as well as in tables 6 and 7, individuals are counted for every military specialty to which their civilian job matches.

by MOS,¹ defining the numbers of civilians required to fill each MOS. Civilians could then be allocated to appropriate MOSs, and bottlenecks would be defined when there were insufficient civilian personnel with the appropriate skills. The difficulty arises when such an allocation scheme is done sequentially: Depending on the order in which the military requirements are entered into the procedure, apparent bottlenecks may be defined in different skill areas.

One of the major sources of this problem is the fact that a single military job may be "filled" by incumbents in different civilian occupations; conversely, a civilian in one occupation may "fill" different military jobs. A simplified example to demonstrate the problem is presented below.

AN EXAMPLE OF THE ALLOCATION PROBLEM

Figure 33 shows three civilian occupations (the number for the problem is actually over 200) and five military occupations (over 3,000 MOS/pay grade categories are actually relevant). The hypothetical totals of civilian incumbents are given in the column totals; the row totals are the hypothetical mobilization requirements for each MOS. "No match" indicates that the particular military and civilian occupations do not crosswalk to each other; empty cells show skills identified as relevant. For example, the 300 incumbents of CIV₁ may be used to fill requirements for MOS₂ or MOS₃ or MOS₄, but they cannot be used to fill requirements for the 150 MOS₁ or the 200 MOS₅ personnel.

Figure 33 shows the basic information with which crosswalk users would begin: (1) the number of civilian incumbents in each occupation; (2) the mobilization requirements for each MOS; and (3) whether or not civilians in an occupation could be used by the military in a particular MOS.

As even this simplified example illustrates, there are numerous ways to allocate the civilians to the military jobs which can utilize their skills. (In the example, we have 1,200 skilled civilians and 1,350 persons needed by the

1. Clearly, there is not a single list of requirements. This discussion uses the current active force mix as a proxy for the mobilization mix of personnel. The CNA National Manpower Inventory model provides users with the option of entering their own mobilization requirements.

military. Some skill matches are multiple; some are not.) The best solution is one in which all the eligible civilians are allocated and all the military requirements are met, or are met as closely as possible.

	CIV ₁	CIV ₂	CIV ₃	MOS requirement
MOS ₁	No match			150
MOS ₂		No match	No match	100
MOS ₃				400
MOS ₄		No match		500
MOS ₅	No match		No match	200
Civilian incumbents	300	400	500	

FIG. 33: HYPOTHETICAL ALLOCATION PROBLEM

It is helpful to think of the requirements as being relative numbers: for example, figure 33 suggests that five times as many individuals are required for MOS₄ as are required for MOS₂. Thinking of the military's mobilization demands in this fashion focuses on the mix of personnel in the military and emphasizes the fixed-factor proportion method that the military usually uses to build personnel units. Each Marine Division, for example, is composed of x number of artillery specialists, y number of mechanics, and z number of transportation experts. In this context, the problem is "How many divisions can be drawn from the civilian sector, given the civilian skill mix for the age, gender, and other restrictions that are placed on personnel?" In making such estimates, the goal is the most efficient allocation of civilians among all the MOSs for which their occupational skills qualify them.

Figure 34 illustrates an initial attempt at a solution for this example. This initial attempt proceeds as follows: For each column, sum the MOS requirements for which there are possible matches. Next, determine the fraction of the requirements for each cell. Finally, allocate the civilian incumbents by these fractions. For the first column, the first step is $100 + 400 + 500 = 1000$. The second step is $100/1000 = 0.1$, $400/1000 = 0.4$, $500/1000 = 0.5$. The third step is $0.1(300) = 30$, $0.4(300) = 120$, $0.5(300) = 150$.

	CIV ₁	CIV ₂	CIV ₃	Row total	MOS requirement	Allocation- requirement ratio
MOS ₁	No match	80	71	151	150	1.0
MOS ₂	30	No match	No match	30	100	0.3
MOS ₃	120	213	191	524	400	1.3
MOS ₄	150	No match	238	388	500	0.8
MOS ₅	No match	107	No match	107	200	0.5
Civilian incumbents	300	400	500			

FIG. 34: INEFFICIENT SOLUTION TO HYPOTHETICAL ALLOCATION PROBLEM

That this solution would be inefficient can be seen most directly from the column entitled "Ratio." This column shows the proportion of requirements met by the current allocation. (It is derived by dividing the row total by the MOS requirement.) In this example, 130 percent of the requirements for MOS₃, but only 30 percent of the requirements for MOS₂, are being met. If military forces are assembled in fixed proportions, only 80 percent of the requirements will be met because of the apparent bottleneck in MOS₄. Inspection of figure 34, however, indicates that incumbents of civilian occupation CIV₁ could be shifted between MOS₂ and MOS₃. Actually, several changes in the solution would make the allocation more efficient.

After making such shifts, a solution such as that presented in figure 35 is derived. In this solution, all requirements are filled at the 90-percent level, and all civilians are allocated. Several points about this solution should be noted. First, although it is efficient, it is arbitrary: many other solutions would be operationally equivalent. For example, individuals in CIV₁ and CIV₃ could be shifted between MOS₃ and MOS₄ without changing the ratios in figure 35. (For example, two civilians in CIV₁ could be moved from MOS₃ to MOS₄ and two civilians in CIV₃ moved from MOS₄ to MOS₃). The arbitrariness of the solution, however, should not be a problem. Users are not actually assigning civilian electronics experts to be Navy ETs. They are merely asking how closely requirements can be met if civilians are allocated efficiently at mobilization.

Second, this particular example provides no specific mobilization bottlenecks, although all military jobs are filled at only 90 percent of

requirements. However, specific bottlenecks of considerable magnitude are clearly possible, particularly if there are gender, age, or other restrictions on appropriate personnel. Figure 36 depicts another example with a bottleneck at MOS₁. Only the first civilian job crosswalks to MOS₁, and this civilian job has few incumbents. Meeting military requirements in this type of situation could cause significant difficulties upon mobilization.

	CIV ₁	CIV ₂	CIV ₃	Row total	MOS requirement	Allocation-requirement ratio
MOS ₁	No match	81	52	133	150	0.9
MOS ₂	89	No match	No match	89	100	0.9
MOS ₃	26	141	190	357	400	0.9
MOS ₄	185	No match	258	443	500	0.9
MOS ₅	No match	178	No match	178	200	0.9
Civilian incumbents	300	400	500			

FIG. 35: EFFICIENT SOLUTION TO HYPOTHETICAL ALLOCATION PROBLEM

	CIV ₁	CIV ₂	CIV ₃	Row total	MOS requirement	Allocation-requirement ratio
MOS ₁	25	No match	No match	25	100	0.25
MOS ₂	No match	100	100	200	100	2.00
MOS ₃	No match	No match	100	100	50	2.00
Civilian incumbents	25	100	200			

FIG. 36: HYPOTHETICAL EXAMPLE OF A BOTTLENECK

These examples point to the real-world complexity of the allocation problem. The matrix contains over 3,000 military jobs, over 400 civilian

occupations, and age, gender, and education restrictions.¹ Although a linear programming solution to the problem was investigated, the dimensions were found to be simply too large for conventional linear programming software. Moreover, such packages are expensive to run and, although computationally feasible, would be empirically impractical because over 200 equations (one for each civilian specialty with any military linkage) and thousands of variables (one variable for each allocation—that is, civilian job/individual MOS) are included. A quick computational procedure was needed—a need that is thrown into even sharper relief by the realization that there is no single demand vector or list of requirements. Force mixes vary depending upon mission, mobilization scenario, and other factors. The procedure must allow the user to input a desired force mix (demand or set of requirements), leaving the calculation of the efficient ratios of requirements to available supply to the computer. With such a procedure, a variety of force mixes could be tested for potential bottlenecks. After exploring other available techniques, a decision was made to develop a procedure specifically for this bottleneck problem.² This procedure is detailed below.

SOLUTION TO THE BOTTLENECK PROBLEM

Let M_i be the mobilization requirement for military job i ($i = 1, 2, \dots, I$). Let C_j be the number of incumbents in civilian job j ($j = 1, 2, \dots, J$). Define W_{ij} to be 1 if civilian job j crosswalks to military job i , and 0 otherwise.

Let A_{ij} be the fraction of civilians in job j that are allocated to military job i . Then the total number of civilians allocated to military job i is

$$N_i = \sum_{j=1}^J C_j A_{ij} .$$

-
1. Any age, education, and gender restrictions entered by the user would define the number of civilian incumbents in each civilian occupation (the column sums).
 2. None of the other techniques explored appeared as efficient as the procedure detailed here.

Note that any allocation scheme A must satisfy the restrictions that

$$\sum_{i=1}^I A_{ij} = 1, A_{ij} \geq 0$$

and

$$A_{ij} = 0 \text{ if } W_{ij} = 0 .$$

Define the ratio of mobilization requirements for military job i to the number of civilians assigned to that job by the allocation scheme as

$$R_i = \frac{M_i}{N_i} .$$

Then, given M , C , and W , an allocation scheme A is an $I \times J$ matrix, and determines the vector R . An efficient allocation scheme is defined as one in which the elements of R are as close together as possible under the given set of constraints.

The procedure used to produce an efficient allocation scheme A is an iterative one, which, at each step, rescales the A_{ij} values in proportion to the values of the R_i ratios they produce. The starting values of A_{ij} are defined as

$$A_{ij}^0 = W_{ij} M_i / \sum_{i=1}^I W_{ij} M_i .$$

This produces an initial R with elements

$$R_i^0 = M_i / \sum_{j=1}^J C_j A_{ij}^0 .$$

At each step of the procedure, new values of A_{ij} and R_i are calculated based on the preceding ones. Given A^n and R^n at the n th stage, A^{n+1} and

R^{n+1} are given by

$$A_{ij}^{n+1} = A_{ij}^n R_i^n / \sum_{i=1}^I A_{ij}^n R_i^n$$

and

$$R_i^{n+1} = M_i / \sum_{j=1}^J C_j A_{ij}^{n+1}.$$

The procedure continues until the maximum change in any R_i^n value is smaller than some chosen value, ϵ .

THE ALLOCATION MODULE IN THE NMI MODEL

The diagram in figure 37 expands upon that in figure 8, adding on the allocation module. As in figure 8, user-supplied restrictions enter the modules from the left. Figure 37 adds the user option of specifying the military's requirements or personnel demands for each military job (defined by DoD occupational group, MOS, MOS/pay grade, etc.) and to efficiently allocate civilian personnel according to these demands. Since wartime mobilization requirements were not available, the current active force inventory is used in this report as a substitute for mobilization demand.¹ (Thus, in the absence of a "requirements vector," the user can employ the current active force mix as a base case.)

EXAMPLE OF SOFTWARE FOR THE ALLOCATION MODULE

A sample run from the allocation module is reproduced below. In this example, the user wishes to estimate civilian supply in occupations with military skills in terms of the DoD taxonomy. In addition, the most efficient allocation of available civilians among DoD specialties is needed so that

1. For information on the plans of each service for augmenting manpower under mobilization, see the reports by Syllogistics (1983) and McFann-Gray (May 1984).

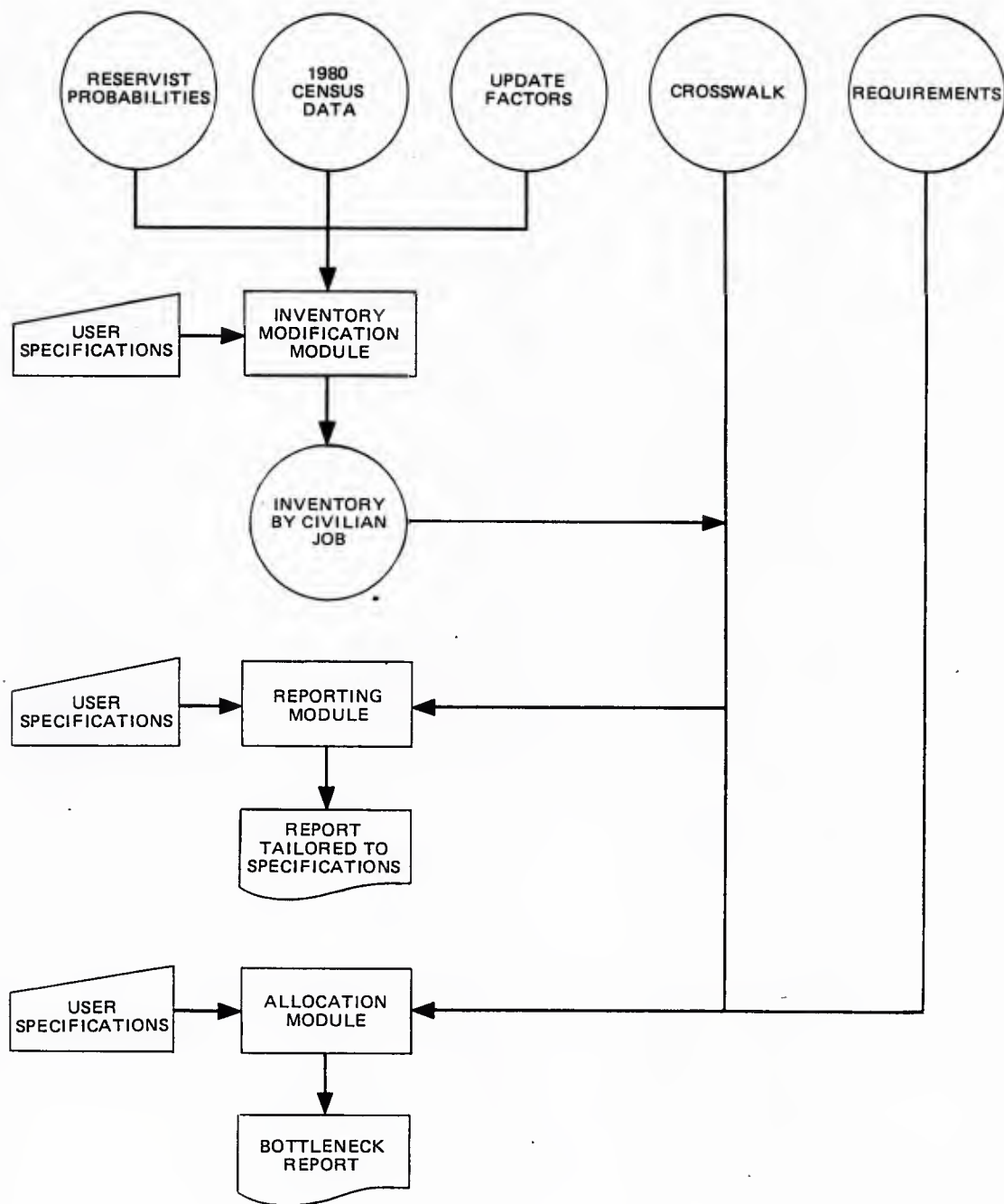


FIG. 37: THE NMI MODEL WITH BOTTLENECK REPORT

potential supply deficiencies can be identified. As with the other examples, user responses appear in boldface type.

This computer program allocates civilians to military jobs and attempts to identify potential mobilization bottlenecks.

Enter the maximum number of iterations:

35

CROSSWALK FIELDS:

- 1 BRANCH
- 2 COMMUNITY
- 3 PAYGRADE
- 4 DOD OCC CODE
- 5 MOS
- 6 MIL TITLE
- 7 BRANCH THRU MOS
- 8 BRANCH THRU TITLE
- 9 SEX
- 10 CENSUS OCCUPATION

What is the variable number in the CROSSWALK file which contains the MILITARY JOB field you wish to utilize?

Enter number:

4

CENSUS INPUT TABULATION FIELDS:

- 1 SEX
- 2 EDUCATION
- 3 CENSUS OCCUPATION

How many CROSSWALK fields will be matched with the CENSUS INPUT TABULATION? For example, both SEX and MOS fields would be necessary to obtain counts which reflect gender restrictions for military jobs.

Enter number:

2

Which CROSSWALK fields will be matched to the CENSUS INPUT field/fields?

Enter CROSSWALK field numbers (enter 0 to see CROSSWALK fields again):

9 10

What is the variable number in the CENSUS INPUT TABULATION for SEX?

Enter number (enter 0 to see Census list again):

1

What is the variable number in the CENSUS INPUT TABULATION for CENSUS OCCUPATION?

Enter number (enter 0 to see Census list again):

3

DEMAND (REQUIREMENTS) FILE FIELDS:

- 1 BRANCH
- 2 COMMUNITY
- 3 PAY
- 4 DOD
- 5 MOS
- 6 BRANCH THRU MOS

What is the variable number in the DEMAND file of the MILITARY JOB field you wish to utilize?

Enter number:

4

After the user has entered specifications that the software will utilize for both restrictions and requirements, the algorithm described above will allocate individuals to the respective military jobs. Since any specific civilian can often perform several different military jobs, the allocation of a particular civilian to a particular military specialty is arbitrary. Thus, an option to detail the demographic characteristics of individuals allocated to particular MOSs would be meaningless.

In regard to gender—usually a straightforward demographic characteristic—one clarification of this point should be made. Specifically, the allocation module is designed to recognize the gender of civilians in occupations with militarily relevant skills. When gender is included along with occupation in the Census input, the software allows only males to be considered eligible for combat (male-only) specialties, as defined by current regulations. (In terms of the “match-no match” civilian-military bottleneck examples given above in figures 33 to 36, female civilian incumbents of combat military specialties are classified as “no-match” cases.) However, if input data include both sexes, and gender is not retained as a variable available in the allocation procedure, the output cannot reflect gender restrictions and will overestimate civilian supply in those military specialties.

In short, when gender is retained in the input, resulting counts for restricted specialties are appropriately restricted to males. In the case of multiple matches, distributions of supply are arbitrary by other demographic characteristics. For example, if CIV₁ is matched to DoD₁, DoD₂ and DoD₃ (or Army₁, Navy₁, and Marine₁), the allocations by age or geography to any single one of those DoD or service occupations would not be relevant and is arbitrary.

Instead, output of the allocation module for each occupation is the ratio of the number of civilians allocated to each mobilization requirement (demand). (See appendix D for an example of the output.) Such ratios will allow users to identify whether the supply of civilians for any specialty appears to be plentiful, roughly adequate, nonexistent, or somewhere between. Obviously, there is no single set of mobilization requirements available or appropriate for empirical input. Therefore, as noted above, as a proxy for mobilization requirements, the module uses the September 1980 active duty personnel mix (defined by MOS and pay grade). With this proxy, ratios basically show how many times current active military levels in each military specialty could be reproduced using the crosswalk data.

Tables 9 and 10 show the output of the allocation module for enlisted personnel, tabulated by 2-digit DoD occupation codes and organized by columns, in ratio ranges. Percentage distributions are by DoD specialties (that is, each row describes 100 percent of the ratio range for each DoD code). For both tables, the civilian mobilization pool was defined as employed civilians (not disabled and not members of SELRES) under 40 years of age. The mobilization pool – using the current force proxies described above – was not restricted to men, but when military gender requirements restricted the occupation to males, only males were allocated.¹

Table 9 restricts the supply of matched civilians for pay grades E-4 and E-5; table 10 examines a wider pay grade range (E-3 through E-9). Five values of the ratio, R (R = civilians allocated/1980 military strength), are presented:

$R = 0$ (no civilians available);

$0 < R \leq 5$ (ratio positive but less than or equal to 5);

$5 < R \leq 10$ (ratio greater than 5 but less than or equal to 10);

$10 < R \leq 50$ (ratio greater than 10 but less than or equal to 50);

$50 < R$ (ratio greater than 50).

1. As suggested earlier, the multiple crosswalk appears to result in a civilian overcount, reflected in many of the high ratios in these tables. Hence, the emphasis here should be placed upon the software capabilities of the model.

The numbers in parentheses next to the ratio are the number of military personnel in the respective category (for example, in the DoD category "01, Infantry," "38,734" is the number of enlisted E-4s and E-5s who had no civilian matches).

As table 9 indicates, only three of the 2-digit DoD occupational categories have no matches in civilian occupations (01 Infantry, 02 Armor and Amphibious, and 21 Sonar). For DoD codes that do have corresponding civilian jobs, the percentage of military requirements with no civilian matches (i.e., column 1 with $R = 0$) varies from 0 percent (52 Clerical/Personnel) to 93 percent (25 Combat Operations Control).

Turning to ratios that exceed 50 ($50 < R$), one finds few DoD codes that contain substantial numbers of civilians. One exception is DoD code 40, Photography, with 82 percent of the requirements having ratios of civilian supply to demand greater than 50. For smaller ratios, deciding what ratio of supply to potential mobilization demand is sufficient is more complex.

TABLE 9

**MOBILIZATION SUPPLY: DOD OCCUPATIONS BY CIVILIAN COUNTS FOR RATIO (R) OF CIVILIANS TO 1980 ACTIVE
DUTY E-4s AND E-5s**

DoD Oco Code	Title	R = 0	0 < R < 5	5 < R < 10	10 < R < 50	50 < R
		Percent Total	Percent Total	Percent Total	Percent Total	Percent Total
01	INFANTRY	100 (38734)	0 (0)	0 (0)	0 (0)	0 (1)
02	ARMOR AND AMPHIBIOUS	100 (9159)	0 (0)	0 (0)	0 (0)	0 (0)
03	COMBAT ENGINEERING	21 (1900)	0 (0)	0 (0)	0 (0)	79 (6975)
04	ARTILLERY/GUNNERY ETC.	91 (19723)	0 (0)	0 (0)	9 (1897)	0 (0)
05	AIR CREW	88 (2476)	12 (324)	0 (0)	0 (0)	0 (0)
06	SEAMANSHIP	7 (529)	25 (1750)	0 (0)	66 (4661)	2 (119)
07	INSTALLATION SECURITY	26 (2802)	0 (0)	74 (7867)	0 (0)	0 (0)
10	RADIO RADAR	23 (8571)	4 (1355)	73 (26854)	0 (14)	0 (0)
11	FIRE CONTROL ELEC. SYS.	17 (766)	0 (0)	83 (3681)	0 (0)	0 (0)
12	MISSILE GUIDANCE ETC.	26 (2729)	0 (0)	83 (6560)	11 (1142)	0 (0)
13	SONAR EQUIPMENT	1 (19)	0 (0)	99 (2761)	0 (0)	0 (0)
14	NUCLEAR WEAPONS	28 (217)	0 (0)	72 (567)	0 (0)	0 (0)
15	ADP COMPUTERS	18 (783)	2 (77)	79 (3410)	0 (0)	1 (25)
16	TELETYPE & CRYPTO. EQUIP.	20 (1361)	0 (0)	80 (5430)	0 (0)	0 (0)
19	OTHER ELECTRONIC EQUIP.	27 (2900)	0 (0)	66 (7233)	5 (565)	2 (215)
20	RADIO AND RADIO CODE	32 (6553)	64 (12897)	0 (0)	4 (754)	0 (0)
21	SONAR	100 (1840)	0 (0)	0 (0)	0 (0)	0 (0)
22	RADAR AND AIR TRAFFIC	58 (7111)	10 (1227)	23 (2772)	0 (0)	9 (1141)
23	SIGNAL INTELL. ELEC WAR.	23 (2488)	54 (5730)	6 (591)	18 (1873)	0 (0)
24	INTELLIGENCE	45 (1666)	0 (0)	19 (709)	36 (1355)	0 (0)
25	COMBAT OPERATIONS CONTROL	93 (8597)	0 (0)	0 (0)	7 (641)	0 (0)
26	COMM. CENTER OPERATIONS	17 (1832)	6 (631)	0 (0)	76 (8175)	1 (137)
30	MEDICAL CARE	18 (4797)	0 (0)	0 (0)	54 (14051)	28 (7414)
31	TECH. MEDICAL SERVICES	23 (1401)	0 (0)	0 (0)	66 (4045)	11 (671)
32	RELATED MEDICAL SERVICES	17 (371)	0 (0)	0 (0)	76 (1648)	7 (158)
33	DENTAL CARE	41 (1861)	0 (0)	0 (0)	42 (1903)	17 (783)
40	PHOTOGRAPHY	18 (568)	0 (0)	0 (0)	0 (0)	82 (2644)
41	MAPPING, SURVEYING, ETC.	10 (368)	0 (0)	0 (0)	50 (1872)	40 (1506)
42	WEATHER	17 (437)	0 (0)	1 (18)	82 (2123)	0 (0)
43	ORD. DISPOSAL & DIVING	22 (141)	0 (0)	78 (503)	0 (0)	0 (0)
45	MUSICIANS	6 (116)	0 (0)	0 (0)	94 (1896)	0 (0)
49	TECH. SPECIALISTS, N.E.C	50 (2828)	0 (0)	0 (0)	44 (2500)	7 (382)
50	PERSONNEL	13 (2311)	0 (0)	0 (0)	86 (15230)	1 (245)

TABLE 9 (Continued)

DoD Ooo Code	Title	R = 0 Percent Total	0 < R < 5 Percent Total	5 < R < 10 Percent Total	10 < R < 50 Percent Total	50 < R Percent Total
51	ADMINISTRATION	18 (5809)	0 (0)	0 (0)	69 (22440)	13 (4346)
52	CLERICAL/PERSONNEL	0 (2)	0 (0)	0 (0)	100 (624)	0 (0)
53	DATA PROCESSING	17 (1128)	0 (0)	0 (0)	0 (24)	83 (5616)
54	ACCOUNTING, FINANCE, ETC.	15 (1050)	0 (0)	0 (0)	22 (1500)	63 (4303)
55	OTHER FUNCTIONAL SUPPORT	19 (9992)	0 (0)	8 (4182)	55 (27976)	18 (9164)
56	RELIGIOUS, MORALE, ETC.	49 (1302)	0 (0)	0 (0)	13 (339)	38 (997)
57	INFORMATION AND EDUCATION	49 (1314)	0 (0)	5 (133)	2 (59)	43 (1153)
60	AIRCRAFT & AIRCRAFT REL.	18 (13247)	76 (55721)	0 (40)	6 (4284)	0 (3)
61	AUTOMOTIVE	7 (2215)	0 (0)	0 (0)	90 (26840)	2 (683)
62	WIRE COMMUNICATIONS	4 (660)	10 (1505)	4 (620)	80 (12395)	2 (235)
63	MISSILE MECH. AND ELEC.	27 (610)	0 (0)	54 (1202)	18 (396)	1 (21)
64	ARMAMENT AND MUNITIONS	15 (2520)	0 (0)	77 (13057)	8 (1357)	0 (0)
65	SHIPBOARD PROPULSION	0 (53)	0 (4)	1 (175)	98 (18007)	1 (115)
66	POWER GENERATING EQUIP.	4 (720)	15 (2434)	0 (67)	78 (12945)	3 (523)
67	PRECISION EQUIPMENT	1 (8)	0 (0)	59 (679)	15 (176)	25 (282)
69	OTHER MECH. & ELEC. EQUIP	10 (93)	0 (0)	6 (55)	20 (182)	65 (602)
70	METALWORKING	21 (1247)	0 (0)	0 (0)	36 (2170)	43 (2607)
71	CONSTRUCTION	16 (1662)	0 (0)	0 (2)	45 (4640)	38 (3911)
72	UTILITIES	32 (2402)	0 (0)	4 (266)	31 (2298)	33 (2479)
74	LITHOGRAPHY	15 (183)	0 (0)	0 (0)	0 (0)	85 (1002)
75	INDUSTRIAL GAS FUEL PROD.	0 (1)	0 (0)	0 (0)	0 (0)	100 (217)
76	FABRIC, LEATHER, & RUBBER	26 (367)	0 (0)	0 (0)	0 (0)	74 (1030)
79	OTHER CRAFTSMEN, N.E.C.	0 (0)	0 (0)	0 (0)	2 (65)	98 (4144)
80	FOOD SERVICE	12 (2238)	0 (0)	0 (0)	88 (16658)	0 (29)
81	MOTOR TRANSPORT	8 (1219)	0 (0)	0 (0)	0 (0)	92 (13994)
82	MATERIAL RECEIPT, ETC.	21 (3047)	1 (192)	0 (0)	46 (6542)	32 (4573)
83	LAW ENFORCEMENT	10 (1803)	0 (0)	0 (0)	90 (16897)	0 (0)
84	PERSONAL SERVICE	47 (438)	0 (0)	0 (0)	0 (0)	53 (494)
86	FORWARD AREA EQUIP. SUPP.	34 (961)	0 (0)	66 (1826)	0 (0)	0 (0)
	TOTAL	29 (202104)	12 (83847)	13 (91260)	35 (245159)	12 (84939)

SOURCE: NMI National Inventory Model.

7,858 active duty personnel are excluded from the analysis because of inappropriate DoD Occupation Codes.

TABLE 10

MOBILIZATION SUPPLY: DOD OCCUPATIONS BY CIVILIAN COUNTS FOR RATIO (R) OF CIVILIANS TO 1980 ACTIVE
DUTY E-3s THROUGH E-9s

DoD Ooo Code	Title	R = 0 Percent Total	0 < R < 5 Percent Total	5 < R < 10 Percent Total	10 < R < 50 Percent Total	50 < R Percent Total
01	INFANTRY	100 (81999)	0 (0)	0 (0)	0 (0)	0 (3)
02	ARMOR AND AMPHIBIOUS	100 (19520)	0 (0)	0 (0)	0 (0)	0 (0)
03	COMBAT ENGINEERING	23 (3886)	0 (0)	0 (0)	1 (105)	76 (12619)
04	ARTILLERY/GUNNERY	92 (37079)	0 (0)	1 (396)	7 (2756)	0 (0)
05	AIR CREW	78 (4912)	22 (1386)	0 (0)	0 (0)	0 (0)
06	SEAMANSHIP	21 (2777)	17 (2313)	0 (0)	59 (7877)	2 (276)
07	INSTALLATION SECURITY	32 (6776)	8 (1625)	60 (12582)	0 (0)	0 (0)
10	RADIO RADAR	26 (17564)	17 (11693)	53 (35669)	4 (2827)	0 (0)
11	FIRE CONTROL ELEC. SYS.	23 (1646)	21 (1476)	56 (4030)	0 (0)	0 (0)
12	MISSILE GUIDANCE ETC.	30 (5502)	13 (2309)	47 (8512)	10 (1839)	0 (0)
13	SONAR EQUIPMENT	36 (1665)	0 (22)	63 (2917)	0 (0)	0 (0)
14	NUCLEAR WEAPONS EQUIP.	44 (550)	0 (0)	56 (699)	0 (0)	0 (0)
15	ADP COMPUTERS	23 (1665)	13 (974)	64 (4691)	0 (0)	1 (50)
16	TELETYPE & CRYPTO EQUIP.	23 (3077)	9 (1213)	67 (8824)	1 (136)	0 (0)
19	OTHER ELECTRONIC EQUIP.	30 (6121)	6 (1233)	51 (10283)	10 (2112)	2 (467)
20	RADIO AND RADIO CODE	38 (13264)	54 (19086)	0 (0)	8 (2810)	0 (0)
21	SONAR	96 (3642)	4 (136)	0 (0)	0 (0)	0 (0)
22	RADAR AND AIR TRAFFIC	61 (13696)	8 (1855)	24 (5333)	0 (76)	7 (1512)
23	SIGNAL INTELL ELECT WAR	41 (8609)	41 (8520)	4 (879)	14 (2884)	0 (0)
24	INTELLIGENCE	57 (4720)	0 (0)	14 (1174)	29 (2446)	0 (0)
25	COMBAT OPER. CONTROL	94 (16379)	0 (0)	0 (0)	6 (975)	0 (0)
26	COMM. CENTER OPERATIONS	14 (2966)	19 (3963)	0 (0)	66 (13794)	1 (172)
30	MEDICAL CARE	20 (9317)	0 (0)	0 (0)	58 (27359)	23 (10687)
31	TECH. MEDICAL SERVICES	25 (2557)	0 (0)	0 (0)	57 (5786)	17 (1755)
32	RELATED MEDICAL SERVICES	24 (1118)	0 (0)	0 (0)	68 (3234)	8 (378)
33	DENTAL CARE	36 (2903)	0 (0)	0 (0)	52 (4203)	12 (978)
40	PHOTOGRAPHY	27 (1525)	0 (0)	0 (0)	6 (336)	68 (3881)
41	MAPPING, SURVEYING, ETC.	10 (677)	0 (0)	1 (38)	53 (3458)	36 (2328)
42	WEATHER	26 (1289)	0 (0)	17 (853)	56 (2769)	0 (0)
43	ORD. DISPOSAL & DIVING	59 (880)	0 (0)	41 (604)	0 (0)	0 (0)
45	MUSICIANS	6 (267)	0 (0)	0 (0)	94 (4264)	0 (3)
49	TECH. SPECIALISTS, N.E.C.	49 (5653)	0 (0)	0 (0)	46 (5345)	6 (650)
50	PERSONNEL	19 (7783)	0 (0)	0 (0)	71 (30003)	10 (4238)

TABLE 10 (Continued)

DoD Occ Code	Title	R = 0	0 < R < 5	5 < R < 10	10 < R < 50	50 < R
		Percent Total	Percent Total	Percent Total	Percent Total	Percent Total
51	ADMINISTRATION	17 (9694)	0 (0)	0 (0)	71 (41601)	12 (7105)
52	CLERICAL/PERSONNEL	4 (222)	0 (0)	0 (0)	85 (5248)	11 (703)
53	DATA PROCESSING	17 (2202)	0 (0)	0 (0)	16 (2104)	67 (8717)
54	ACCOUNTING, FINANCE, ETC.	22 (2912)	0 (0)	0 (0)	29 (3802)	48 (6316)
55	OTHER FUNCTIONAL SUPPORT	20 (19754)	0 (0)	19 (18531)	45 (43634)	15 (14493)
56	RELIGIOUS, MORALE, ETC	46 (2221)	0 (0)	0 (0)	19 (890)	35 (1700)
57	INFORMATION AND EDUCATION	53 (3038)	2 (100)	3 (151)	2 (133)	40 (2294)
60	AIRCRAFT & AIRCRAFT REL.	19 (26169)	63 (87367)	0 (52)	18 (25665)	0 (20)
61	AUTOMOTIVE	10 (4990)	0 (0)	0 (0)	89 (45457)	2 (901)
62	WIRE COMMUNICATIONS	7 (1715)	8 (1942)	4 (1058)	79 (19378)	1 (332)
63	MISSILE MECH. AND ELECT.	47 (2063)	0 (18)	42 (1840)	9 (413)	1 (35)
64	ARMAMENT AND MUNITIONS	28 (8769)	3 (1045)	61 (18860)	7 (2119)	0 (134)
65	SHIPBOARD PROPULSION	18 (5656)	2 (672)	1 (414)	78 (24198)	0 (154)
66	POWER GENERATING EQUIP.	22 (5588)	12 (3131)	1 (172)	62 (15985)	4 (938)
67	PRECISION EQUIPMENT	8 (200)	1 (35)	60 (1500)	16 (394)	14 (358)
69	OTHER MECH & ELECT. EQUIP	13 (193)	6 (98)	6 (94)	26 (388)	49 (741)
70	METALWORKING	28 (3435)	0 (0)	0 (0)	36 (4355)	36 (4331)
71	CONSTRUCTION	20 (4061)	0 (0)	0 (5)	46 (9427)	34 (6986)
72	UTILITIES	36 (5466)	0 (0)	4 (596)	34 (5086)	26 (3962)
74	LITHOGRAPHY	15 (286)	0 (0)	0 (0)	19 (357)	66 (1255)
75	INDUSTRIAL GAS/FUEL PROD.	27 (171)	0 (0)	0 (0)	1 (9)	72 (461)
76	FABRIC, LEATHER, & RUBBER	19 (451)	0 (0)	0 (0)	2 (59)	79 (1879)
79	OTHER CRAFTSMEN, N.E.C.	25 (1814)	0 (0)	0 (0)	2 (146)	73 (5332)
80	FOOD SERVICE	15 (5882)	0 (0)	0 (0)	85 (34142)	0 (145)
81	MOTOR TRANSPORT	8 (2179)	0 (0)	0 (0)	15 (4165)	77 (21182)
82	MATERIAL RECEIPT, ETC.	19 (5217)	2 (586)	5 (1299)	46 (12654)	28 (7642)
83	LAW ENFORCEMENT	10 (3472)	0 (0)	0 (0)	90 (31850)	0 (46)
84	PERSONAL SERVICE	62 (1000)	0 (0)	0 (0)	0 (0)	38 (615)
86	FORWARD AREA EQUIP. SUPP.	52 (2780)	0 (0)	48 (2595)	0 (0)	0 (0)
Total		32 (423584)	12 (152798)	11 (144651)	35 (461053)	10 (138774)

SOURCE: NMI National Inventory Model.

56,539 active duty personnel are excluded from the analysis because of inappropriate DoD Occupation Codes.

SUMMARY

A flexible tool for assessing the inventory of civilian manpower for mobilization purposes has been developed. The results obtained, or the output of the model, will depend upon the requirements/constraints specified by the user. Different requirements, generated by different wartime scenarios, will create different bottlenecks. In addition, if the civilian pool is defined as males under the age of 25, the model will indicate that the inventory is smaller than that produced under less stringent restrictions. That is as it should be. Since there is no single list of mobilization restrictions or requirements, the model needs to retain flexibility. However, if timely and significant augmentation of military forces is required, these potential bottlenecks must be identified and dealt with in mobilization planning.

The model has been constructed so that other modules can be added. Perhaps the most compelling need is for the addition of the personnel demands that mobilization would make upon industry. There are presently several "industrial base" mobilization models that calculate the abilities of industry to meet wartime demands. The industry-of-employment parameter in the current NMI database provides the linkage needed for integration of industrial mobilization requirements. A model that integrates both military and industrial demands for personnel would provide a much more accurate picture of the country's mobilization readiness.

REFERENCES

Carey, M. L. 1981. "Occupational Employment Growth Through 1990." *Monthly Labor Review* 104(2): 42-55.

Congressional Research Service, Library of Congress. May 1985. *An Update on the Status of Major Federal Statistical Agencies, Fiscal Year 1986*. A Report prepared for the Committee on Government Operations, House of Representatives, 99th Congress, 1st session. Washington, D.C.: Government Printing Office.

Goldstein, Harold. 1971. "The New Federal-State Employment Statistics Program." *Monthly Labor Review* 94(10): 12-17.

Green, G. P., K. tan Dinh, J. A. Priebe, and R. R. Tucker. February 1983. "Revisions in the Current Population Survey Beginning in January 1983." In *Employment and Earnings*, pp. 7-15.

Miller, A. R., D. J. Trieman, P. S. Cain, P. A. Roos (eds.). 1980. *Work, Jobs, and Occupations: A Critical Review of the Dictionary of Occupational Titles*. Washington, D.C.: National Academy Press.

National Commission on Employment and Unemployment Statistics. 1979. *Counting the Labor Force*. Washington, D.C.: Government Printing Office.

National Occupational Information Coordinating Committee. January 1981. *Occupational Information System Handbook*. Vol. 1: Vocational Preparation and Occupations, 3rd ed. Vol. 2: Occupational Information Analysis, Presentation and Delivery. Washington, D.C.

McFann-Gray and Associates, Inc. May 1984. *The National Manpower Inventory: Definition and Identification of Critical Military Occupations*. MGA 2383-SRO. San Antonio, Texas.

Silva, W. S. May 1983. *A National Manpower Inventory System: A Developmental Perspective*. McFann-Gray and Associates, Inc. Prepared for OASD(MRA&L), contract F41689-82-C-0054.

Syllogistics, Inc. July 1983. *Critical Skills in the Military Services: A Draft Report*. Springfield, Virginia.

REFERENCES (Continued)

U.S. Congress, House. 1980. *Conference Report to H.R. 6974, Sec. 303: Comprehensive Manpower Mobilization Plan*. 96th Congress, 2nd session.

U.S. Department of Commerce, Bureau of the Census. March 1982. *User's Guide: Part A (text), Part B (glossary)*.

U.S. Department of Commerce, Bureau of the Census. December 1982. *Census of Population and Housing, 1980: Public-Use Microdata Sample Files, Technical Documentation*. Preliminary issue. Washington, D.C.

U.S. Department of Commerce, Bureau of the Census. 1982a. *1980 Census of Population: Alphabetical Index of Industries and Occupations*, final ed. Washington, D.C.: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1982b. *1980 Census of Population: Classified Index of Industries and Occupations*, final ed. Washington, D.C.: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1984. *1980 Census of Population Summary Volume: Characteristics of the Population*. Washington, D.C.: Government Printing Office, PC80-1-D1-A.

U.S. Department of Commerce, Office of Federal Statistical Policy and Standards. 1977. *1977 Supplement to Standard Industrial Classification Manual*. Washington, D.C.: Government Printing Office.

U.S. Department of Commerce, Office of Federal Statistical Policy and Standards. 1980. *Occupational Classification Manual*. Washington, D.C.: Government Printing Office.

U.S. Department of Defense, Armed Services Vocational Testing Group. July 1975. *Military-Civilian Occupational Source Book*, 1st ed., DoD 1304.12Y. San Antonio, Texas: Randolph Air Force Base.

U.S. Department of Defense, Military Enlistment Processing Command. January 1978. *Military-Civilian Occupational Source Book*. Fort Sheridan, Illinois.

REFERENCES (Continued)

U.S. Department of Defense, Office of the Assistant Secretary of Defense. December 1982. *Occupational Conversion Manual: Enlisted/Officer/Civilian*. Washington, D.C.: Defense Manpower Data Center.

U.S. Department of Education, Office of Educational Research and Improvements, National Center for Educational Statistics. February 1981. *A Classification of Instructional Programs*.

U.S. Department of Labor, Bureau of Labor Statistics. April 1979. *Occupational Employment Statistics Handbook*. Washington, D.C.

U.S. Department of Labor, Bureau of Labor Statistics. April 1981. *The National Industry-Occupation Employment Matrix, 1970, 1978 and Projected 1990*, vols. I and II (Bulletin 2086). Washington, D.C.: Government Printing Office.

U.S. Department of Labor, Bureau of Labor Statistics. December 1982. *BLS Handbook of Methods*, vols. I and II. Washington, D.C.: Government Printing Office.

U.S. Department of Labor, Bureau of Labor Statistics. January 1984. *Employment and Earnings*.

U.S. Department of Labor, Bureau of Labor Statistics. *Occupational Outlook Handbook*. Washington, D.C.: Government Printing Office, published yearly.

U.S. Department of Labor, Employment and Training Administration. 1977. *Dictionary of Occupational Titles*, 4th ed. Washington, D.C.: Government Printing Office.

U.S. Department of Labor, Employment and Training Administration. 1982. *Dictionary of Occupational Titles, 4th Edition, Supplement*. Washington, D.C.: Government Printing Office.

APPENDIX A

**SAMPLES OF THE CNA-CONSTRUCTED
CROSSWALK DICTIONARY**

Census Code or MOSC	Service Community	DOT Code	DOT Title	Pay grade range	Career Progression
229 COMPUTER PROGRAMMERS	020167010	PROGRAMMER, CHIEF, BUSINESS	16 16	.	
53A	7E GK 1 2	APPLICATIONS SOFTWARE ANALYSIS AND DESIGN	16 16	.	
53B	7E GK 1 2	AUTOMATED INFORMATION SYSTEMS MANAGEMENT	00 00	.	
9710	7E GK 2 8	ADP PROGRAMS OFFICER	00 00	.	
4010	7E GK 4 7	DATA SYSTEMS SOFTWARE OFFICER (II, III)	36 36	.	
22	7E GK 5 2	DATA PROCESSING	7 7	.	
74F40	532 GK 1 1	PROGRAMMER/ANALYST	67 67	.	
51171	532 GK 3 1	COMPUTER PROGRAMMING TECHNICIAN	79 79	.	
40637-9	532 GK 4 1	PROGRAMMER, ALC	79 79	.	
40667-9	532 GK 4 1	PROGRAMMER, EOL	79 79	.	
40637-9	532 GK 4 1	PROGRAMMER, COBOL	67 69	.	
DP6-7	531 JK 2 1	DATA PROCESSING TECHNICIAN, FIRST CLASS TO CHIEF	67 69	.	
DP6-7	531 JK 5 1	DATA PROCESSING TECHNICIAN, FIRST CLASS TO CHIEF	67 69	.	
DPCS	531 JK 5 1	DATA PROCESSING TECHNICIAN, SENIOR CHIEF	8 89	.	
229 COMPUTER PROGRAMMERS	020167022	PROGRAMMER, ENGINEERING AND SCIENTIFIC			
229 COMPUTER PROGRAMMERS	020187010	PROGRAMMER, INFORMATION SYSTEM			
233 TOOL PROGRAMMERS, NU	007167010	TOOL PROGRAMMER, NUMERICAL CONTROL			
233 TOOL PROGRAMMERS, NU	020187014	PROGRAMMER, PROCESS CONTROL			
234 LEGAL ASSISTANTS	119167014	PATENT AGENT			
234 LEGAL ASSISTANTS	119167010	TITLE SUPERVISOR			
234 LEGAL ASSISTANTS	119267010	POSTFACTOR			
234 LEGAL ASSISTANTS	119267010	CONTRACT CLERK			
234 LEGAL ASSISTANTS	119267022	LEGAL INVESTIGATOR			
234 LEGAL ASSISTANTS	119267026	PARALEGAL ASSISTANT			
4420	5F CL 4 8	LEGAL SERVICES OFFICER	00 00	.	
713A	5F GL 1 3	LEGAL ADMINISTRATIVE TECHNICIAN	14 14	.	
70570	512 GL 3 1	LEGAL SERVICES TECHNICIAN	67 69	.	
44216-9	512 GL 4 1	LEGAL SERVICES SPECIALIST	69 69	.	
71010-30	512 JL 1 1	LEGAL CLERK	36 39	.	
LN6-7	512 JL 2 1	LEGALMAN, FIRST CLASS TO CHIEF	67 69	.	
234 LEGAL ASSISTANTS	119287010	TITLE EXAMINER			
234 LEGAL ASSISTANTS	119367010	ESCPON OFFICER			
234 LEGAL ASSISTANTS	162267010	TITLE CLERK			
234 LEGAL ASSISTANTS	209367046	TITLE SEARCHER			
235 TECHNICIANS, N.E.C.	024284010	PROSPECTOR			
235 TECHNICIANS, N.E.C.	099327010	TEACHER AIDE 1			
235 TECHNICIANS, N.E.C.	100367010	LIBRARY TECHNICAL ASSISTANT			
235 TECHNICIANS, N.E.C.	102367010	FINE ARTS PACKER			
235 TECHNICIANS, N.E.C.	199171010	PROOF TECHNICIAN			
6558	4E EW 2 6	TORPEDO TEST OFFICER	00 00	.	
235 TECHNICIANS, N.F.C.	199251010	TESTER, FOOD PRODUCTS			
235 TECHNICIANS, N.E.C.	199261010	TAXIDERMIST			
235 TECHNICIANS, N.E.C.	199267010	BALLISTICS EXPERT, FORENSIC			
951AS	7H ML 1 3	CRIMINAL INVESTIGATOR-FIREARMS AND TOOLMARK EXAMINER	14 14	.	
235 TECHNICIANS, N.E.C.	199267010	EXAMINATION PROCTOR			
235 TECHNICIANS, N.F.C.	199267022	EXAMINER, QUESTIONED DOCUMENTS			
951AP	7H ML 1 3	CRIMINAL INVESTIGATOR-QUESTIONED DOCUMENTS EXAMINER	14 14	.	

DOD IDOS
Code Code

Military job titles matched to DOT above

523 ELECTRONIC REPAIRERS	828281014	ELECTRONICS-MECHANIC APPRENTICE		
523 ELECTRONIC REPAIRERS	828281022	RADIOACTIVITY-INSTRUMENT MAINTENANCE TECHNICIAN		
523 ELECTRONIC REPAIRERS	829281014	ELECTRICAL REPAIRER		
IC4775-76	623 PB 2 1	PLOTTING SYSTEM TECHNICIAN	46 46	
IC4-6	623 PB 2 1	INTERIOR COMM ELECTRICIAN, THIRD CLASS TO FIRST CLASS	46 48	
IC4771-73	623 PB 2 1	PLOTTING SYSTEMS TECHNICIAN	46 46	
IC4774	623 PB 2 1	PLOTTING SYSTEMS TECHNICIAN	47 47	
EM4666	647 PB 2 1	MINESWEEPING ELECTRICIAN	47 47	
EM4632	662 PB 2 1	FFG-7 CLASS AUXILIARIES ELEC SYSTEM TECHNICIAN	57 57	1
EM4631	662 PB 2 1	FFG-7 CLSS AUXILIARIES ELEC SUBSYSTEM TECHNICIAN	35 35	1
EM4626	662 PB 2 1	DD-963 ELECTRICAL COMPONENT MAINTENANCE TECHNICIAN	49 49	
EM4669	662 PB 2 1	UNREP ELEC COMPON MAINTENANCEMAN (UNITED CONTROL)	38 38	
EM4668	662 PB 2 1	UNREP ELEC COMPONENT MAINTENANCEMAN (DENISON CONTROLS)	37 37	
IC4762	690 PB 2 1	ELECTROLYTIC OXY GENERATOR (M 7L16) ELEC SUPPT TECH	37 37	
51R10-20	721 PB 1 1	INTERIOR ELECTRICIAN	35 35	
CE4-5	721 PB 2 1	CONSTRUCTION ELECTRICIAN, THIRD TO SECOND CLASS	45 48	
54250	721 PB 3 1	ELECTRICIAN	35 37	
1142	721 PB 4 1	ELECTRICAL EQUIPMENT REPAIR SPECIALIST	36 36	
IC4701	651 PR 2 1	AUTOMATED PROPULSION CONTROL SYSTEM MAINT TECHNICIAN	47 47	
IC4752	690 PR 2 1	ELECTROLYTIC OXY GENERATOR (M 6L16) MAINT TECH	37 37	
523 ELECTRONIC REPAIRERS	829281022	SOUND TECHNICIAN		
IC4711	623 PB 2 1	INTERIOR VOICE COMMUNICATIONS SYSTEM MAINT TECHNICIAN	57 57	
IC4-6	623 PB 2 1	INTERIOR COMM ELECTRICIAN, THIRD CLASS TO FIRST CLASS	46 48	
TT4-6	623 PB 5 1	TELEPHONE TECHNICIAN, THIRD TO FIRST CLASS	46 47	
IC4746	191 PJ 2 1	CLOSED CIRCUIT TV TECHNICIAN	37 37	
30455	191 PJ 3 1	TELEVISION EQUIPMENT SPECIALIST	35 37	
523 ELECTRONIC REPAIRERS	952364010	TROUBLE SHOOTER 1		
523 ELECTRONIC REPAIRERS	959367010	ELECTRIC POWERLINE EXAMINER		
523 ELECTRONIC REPAIRERS	959367014	FACILITY EXAMINER		
525 DATA PROCESSING EQUI	633261010	ASSEMBLY TECHNICIAN		
34B10-20	150 PK 1 1	PUNCH CARD MACHINE REPAIRER	35 37	
525 DATA PROCESSING EQUI	729281042	WIREP		
526 HOUSEHOLD APPLIANCE	637261010	AIR-CONDITIONING INSTALLER-SERVICER, WINDOW UNIT		
526 HOUSEHOLD APPLIANCE	723381010	ELECTRICAL-APPLIANCE REPAIRER		
526 HOUSEHOLD APPLIANCE	723381014	VACUUM CLEANER REPAIRER		
526 HOUSEHOLD APPLIANCE	723584010	APPLIANCE REPAIRER		
526 HOUSEHOLD APPLIANCE	729281022	ELECTRIC-TOOL REPAIRER		
BU5908	712 PA 2 1	TOOL AND EQUIPMENT TECHNICIAN	57 57	
526 HOUSEHOLD APPLIANCE	731684022	TOY-ELECTRIC-TRAIN REPAIRER		
526 HOUSEHOLD APPLIANCE	827261010	ELECTRICAL-APPLIANCE SERVICER		
526 HOUSEHOLD APPLIANCE	827261014	ELECTRICAL-APPLIANCE-SERVICER APPRENTICE		
526 HOUSEHOLD APPLIANCE	827464010	AIR-CONDITIONING INSTALLER, DOMESTIC		
526 HOUSEHOLD APPLIANCE	827661010	HOUSEHOLD-APPLIANCE INSTALLER		
527 TELEPHONE LINE INSTA	728281010	ELECTRIC-CABLE DIAGRAMER		
527 TELEPHONE LINE INSTA	822381014	LINE INSTALLER-REPAIRER		
36C10-20	621 PB 1 1	WIRE SYSTEMS INSTALLER/OPERATOR	35 38	
36K10	621 PB 1 1	TACTICAL WIPE OPERATIONS SPECIALIST	34 35	
36150	621 PB 3 1	CABLE AND ANTENNA SYSTEMS INSTALLATION/MAINT SPEC	35 37	
25133-5	621 PB 4 1	CONSTRUCTION WIREMAN	35 35	
25123-4	621 PB 4 1	FIELD WIREMAN	34 35	
28113-6	623 PB 4 1	TELEPHONE TECHNICIAN	36 39	

a "1" in this field indicates gender restrictions (males only)

225	SCIENCE TECHNICIANS, 199167010 RADIATION MONITOR			
9591	491 G7 2 1 RADIOLOGICAL CONTROL MONITOR	46	46	•
225	SCIENCE TECHNICIANS, 937167010 TECHNICAL OPERATOR			
226	AIRPLANE PILOTS AND 196167010 CHIEF PILOT			•
1416	2G T2 3 2 AIR OPERATIONS STAFF OFFICER, PILOT	6	6	•
1455	2G T2 3 2 AIR OPERATIONS OFFICER, PILOT (FIGHTER/SPEC TACTICS)	35	35	•
1485	2G T2 3 2 AIR OPERATIONS OFFICER, PILOT (HELICOPTER/S AND R)	35	35	•
1425	2G T2 3 2 AIR OPERATIONS OFFICER, PILOT (TRANSPORT/AIRLIFT)	35	35	•
1445	2G T2 3 2 AIR OPERATIONS OFFICER, PILOT (SPEC OPS/TACT AIR COM)	35	35	•
1495	2G T2 3 2 AIR OPERATIONS OFFICER, PILOT (AIR OPS, GENERAL)	35	35	•
1435	2G T2 3 2 AIR OPERATIONS OFFICER, PILOT (BOMBARDMENT/REFUELING)	35	35	•
1475	2G T2 3 2 AIR OPERATIONS OFFICER, PILOT (RECON/ELEC WAR/AIRBORN)	35	35	•
226	AIRPLANE PILOTS AND 196167014 NAVIGATOR			•
8557	2D GQ 2 2 NAVIGATOR, AERIAL	16	16	•
8563	2D GQ 2 2 NAVIGATOR/ELECTRONIC COUNTERMEASURES OFFICER	16	16	•
8520	2D GQ 2 2 BOMBARDIER/NAVIGATOR	16	16	•
1545	2D GQ 3 2 NAVIGATOR, AIRLIFT	15	15	•
1535	2D GQ 3 2 NAVIGATOR, GENERAL	15	15	•
1565	2D GQ 3 2 NAVIGATOR, RECON/AIRBORNE COMMAND AND CONTROL	15	15	•
1585	2D GQ 3 2 NAVIGATOR, SPECIAL OPERATIONS	15	15	•
1525	2D GQ 3 2 NAVIGATOR-BOMBARDIER, STRATEGIC	15	15	•
1555	2D GQ 3 2 WEAPONS SYSTEMS OFFICER	15	15	•
1575	2D GQ 3 2 ELECTRONIC WARFARE OFFICER	15	15	•
7588	2D GQ 4 2 ELECTRONICS WARFARE OFFICER, EA-6B	16	16	1•
7585	2D GQ 4 2 AIRBORNE RECONNAISSANCE OFFICER, RF-4B	16	16	1•
7583	2D GQ 4 2 BOMBARDIER-NAVIGATOR, A-6	16	16	1•
7586	2D GQ 4 2 ELECTRONICS WARFARE/AIRBORNE RECON OFF, EA-6A/RF-4B	16	16	1•
7581	2D GQ 4 2 BASIC NAVAL FLIGHT OFFICER	16	16	1•
7587	2D GQ 4 2 AIRBORNE RADAR INTERCEPT OFFICER, F-4N/J/S	16	16	1•
7584	2D GQ 4 2 ELECTRONICS WARFARE OFFICER, EA-6A	16	16	1•
7380	2D GQ 4 3 AERIAL NAVIGATION OFFICER (III)	14	14	•
2875	4D GQ 3 2 EXPERIMENTAL TEST NAVIGATOR	15	15	•
7372	051 GQ 4 1 FIRST NAVIGATOR	19	19	•
8678	2G T2 2 2 SQUADRON NAVIGATION OFFICER	16	16	•
2225	2G T2 3 2 AIR OPERATIONS OFFICER, NAVIGATOR (STRATEGIC)	35	35	•
2245	2G T2 3 2 AIR OPERATIONS OFFICER, NAVIGATOR (AIRLIFT)	35	35	•
2265	2G T2 3 2 AIR OPERATIONS OFFICER, NAVIGATOR (RECONNAISSANCE)	35	35	•
2285	2G T2 3 2 AIR OPERATIONS OFFICER, NAVIGATOR (SPEC OPERATIONS)	35	35	•
2255	2G T2 3 2 AIR OPERATIONS OFFICER, NAVIGATOR (WEAPON SYSTEMS)	35	35	•
2216	2G T2 3 2 AIR OPERATIONS STAFF OFFICER, NAVIGATOR	6	6	•
2295	2G T2 3 2 AIR OPERATIONS OFFICER, NAVIGATOR (AIR OPS GENERAL)	35	35	•
2275	2G T2 3 2 AIR OPERATIONS OFFICER, NAVIGATOR (ELECTRO WARFARE)	35	35	•
2235	2G T2 3 2 AIR OPERATIONS OFFICER, NAVIGATOR (GENERAL)	35	35	•
226	AIRPLANE PILOTS AND 196223010 INSTRUCTOR, FLYING 1			•
8592	28 GQ 2 5 FLIGHT INSTRUCTOR, TRAINING PLANES	00	00	•
8543	28 GQ 2 2 INSTRUMENT FLIGHT INSTRUCTOR-PILOT	16	16	•
8593	28 GQ 2 2 FLIGHT INSTRUCTOR-PILOT, FLEET OPERATIONAL AIRCRAFT	16	16	•

APPENDIX B

**CENSUS OCCUPATIONS AND THEIR CROSSWALK TO
MILITARY OCCUPATIONS**

APPENDIX B

CENSUS OCCUPATIONS AND THEIR CROSSWALK TO MILITARY OCCUPATIONS

Census occupation	Enlisted match	Officer match	No match
MANAGERIAL AND PROFESSIONAL SPECIALTY OCCUPATIONS			
Executive, Administrative, and Managerial Occupations			
003 Legislators			X
004 Chief executives and general administrators, public administration			X
005 Administrators and officials, public administration	X	X	
006 Administrators, protective services	X		
007 Financial managers		X	
008 Personnel and labor relations managers	X	X	
009 Purchasing managers	X	X	
013 Managers, marketing, advertising, and public relations			X
014 Administrators, education and related fields	X	X	
015 Managers, medicine and health	X	X	
016 Managers, properties and real estate	X		
017 Postmasters and mail superintendents	X	X	
018 Funeral directors		X	
019 Managers and administrators, n.e.c. ¹	X	X	
Management-related occupations			
023 Accountants and auditors	X	X	
024 Underwriters			X
025 Other financial officers		X	
026 Management analysts	X	X	
027 Personnel, training, and labor relations specialists	X	X	
028 Purchasing agents and buyers, farm products			X
029 Buyers, wholesale and retail trade, except farm products			X
033 Purchasing agents and buyers, n.e.c.	X	X	
034 Business and promotion agents			X
035 Construction inspectors	X		
036 Inspectors and compliance officers, except construction	X	X	
037 Management-related occupations, n.e.c.	X	X	

1. n.e.c., not elsewhere classified.

<u>Census occupation</u>	<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
Professional Speciality Occupations			
Engineers, architects, and surveyors			
043 Architects		X	
Engineers			
044 Aerospace engineers		X	
045 Metallurgical and materials engineers		X	
046 Mining engineers			X
047 Petroleum engineers			X
048 Chemical engineers			X
049 Nuclear engineers		X	
053 Civil engineers	X	X	
054 Agricultural engineers		X	
055 Electrical and electronic engineers		X	
056 Industrial engineers	X	X	
057 Mechanical engineers		X	
058 Marine engineers and naval architects		X	
059 Engineers, n.e.c.		X	
063 Surveyors and mapping scientists	X	X	
Mathematical and computer scientists			
064 Computer systems analysts and scientists	X	X	
065 Operations and systems researchers and analysts		X	
066 Actuaries			X
067 Statisticians		X	
068 Mathematical scientists, n.e.c.	X	X	
Natural scientists			
069 Physicists and astronomers		X	
073 Chemists, except biochemists		X	
074 Atmospheric and space scientists	X	X	
075 Geologists and geodesists		X	
076 Physical scientists, n.e.c.		X	
077 Agricultural and food scientists		X	
078 Biological and life scientists		X	
079 Forestry and conservation scientists			X
083 Medical scientists		X	
Health-diagnosing occupations			
084 Physicians		X	
085 Dentists		X	
086 Veterinarians		X	
087 Optometrists		X	
088 Podiatrists		X	
089 Health-diagnosing practitioners, n.e.c.			X

<u>Census occupation</u>		<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
Health assessment and treating occupations				
095	Registered nurses		X	
096	Pharmacists		X	
097	Dietitians		X	
Therapists				
098	Inhalation therapists	X		
099	Occupational therapists		X	
103	Physical therapists		X	
104	Speech therapists			
105	Therapists, n.e.c.			X
106	Physicians' assistants	X	X	
Teachers, postsecondary				
113	Earth, environmental, and marine science teachers			X
114	Biological science teachers			X
115	Chemistry teachers			X
116	Physics teachers			X
117	Natural science teachers, n.e.c.			X
118	Psychology teachers			X
119	Economics teachers			X
123	History teachers			X
124	Political science teachers			X
125	Sociology teachers			X
126	Social science teachers, n.e.c.			X
127	Engineering teachers			X
128	Mathematical science teachers			X
129	Computer science teachers			X
133	Medical science teachers			X
134	Health specialties teachers		X	
135	Business, commerce, and marketing teachers			X
136	Agriculture and forestry teachers			X
137	Art, drama, and music teachers			X
138	Physical education teachers			X
139	Education teachers			X
143	English teachers			X
144	Foreign language teachers			X
145	Law teachers			X
146	Social work teachers			X
147	Theology teachers			X
148	Trade and industrial teachers			X
149	Home economics teachers			X
153	Teachers, postsecondary, n.e.c.	X	X	
154	Postsecondary teachers, subject not specified			X

<u>Census occupation</u>		<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
Teachers, except postsecondary				
155	Teachers, prekindergarten and kindergarten			X
156	Teachers, elementary school			X
157	Teachers, secondary school			X
158	Teachers, special education			X
159	Teachers, n.e.c.	X	X	
163	Counselors, educational and vocational	X		
Librarians, archivists, and curators				
164	Librarians	X	X	
165	Archivists and curators		X	
Social scientists and urban planners				
166	Economists			X
167	Psychologists	X	X	
168	Sociologists			X
169	Social scientists, n.e.c.	X	X	
173	Urban planners			X
Social, recreation, and religious workers				
174	Social workers	X	X	
175	Recreation workers	X		
176	Clergy	X	X	
177	Religious workers, n.e.c.	X	X	
Lawyers and judges				
178	Lawyers		X	
179	Judges		X	
Writers, artists, entertainers, and athletes				
183	Authors	X		
184	Technical writers			X
185	Designers	X		
186	Musicians and composers	X	X	
187	Actors and directors	X	X	
188	Painters, sculptors, craft-artists, and artist printmakers	X		
189	Photographers	X	X	
193	Dancers			X
194	Artists, performers, and related workers, n.e.c.	X	X	
195	Editors and reporters	X	X	
197	Public relations specialists	X	X	
198	Announcers	X		
199	Athletes			X

<u>Census occupation</u>		<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
TECHNICAL, SALES, AND ADMINISTRATIVE SUPPORT OCCUPATIONS				
Technician and Related Support Occupations				
Health technologists and technicians				
203	Clinical laboratory technologists and technicians	X	X	
204	Dental hygienists	X		
205	Health record technologists and technicians	X		
206	Radiologic technicians	X		
207	Licensed practical nurses	X		
208	Health technologists and technicians, n.e.c.	X	X	
Technologists and technicians, except health				
Engineering and related technologists and technicians				
213	Electrical and electronic technicians	0 ¹		
214	Industrial engineering technicians			X
215	Mechanical engineering technicians			X
216	Engineering technicians, n.e.c.	X		
217	Drafting occupations	X		
218	Surveying and mapping technicians	X	X	
Science technicians				
223	Biological technicians			X
224	Chemical technicians	X		
225	Science technicians, n.e.c.	X	X	
Technicians, except health, engineering, and science				
226	Airplane pilots and navigators	X	X	
227	Air traffic controllers	X	X	
228	Broadcast equipment operators	X	X	
229	Computer programmers	X	X	
233	Tool programmers, numerical control			X
234	Legal assistants	X		
235	Technicians, n.e.c.	X		
Sales Occupations				
243	Supervisors and proprietors, sales occupations	X	X	
Sales representatives, finance and business services				
253	Insurance sales occupations			X
254	Real estate sales occupations			X
255	Securities and financial service sales occupations			X
256	Advertising and related sales occupations			X
257	Sales occupations, other business services			X

1. These Census codes were matched by the procedure explained in the text.

<u>Census occupation</u>	<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
Sales representatives, commodities except retail			
258 Sales engineers			X
259 Sales representatives, mining, manufacturing, and wholesale			X
Sales workers, retail and personal services			
263 Sales workers, motor vehicles and boats			X
264 Sales workers, apparel			X
265 Sales workers, shoes			X
266 Sales workers, furniture and home furnishings			X
267 Sales workers, radio, television, hi-fi, and appliances			X
268 Sales workers, hardware and building supplies			X
269 Sales workers, parts			X
274 Sales workers, other commodities	X		
275 Sales counter clerks			X
276 Cashiers	X		
277 Street and door-to-door sales workers			X
278 News vendors			X
Sales-related occupations			
283 Demonstrators, promoters and models, sales			X
284 Auctioneers			X
285 Sales support occupations, n.e.c.			X
Administrative Support Occupations, Including Clerical Supervisors, administrative support occupations			
303 Supervisors, general office	X		
304 Supervisors, computer equipment operators	X		
305 Supervisors, financial records processing	X		
306 Chief communications operators	X		
307 Supervisors, distribution, scheduling, and adjusting clerks	X	X	
Computer equipment operators			
308 Computer operators	X		
309 Peripheral equipment operators	X		
Secretaries, stenographers, and typists			
313 Secretaries	X		
314 Stenographers	X		
315 Typists	X		
Information clerks			
316 Interviewers	X		
317 Hotel clerks	X		

<u>Census occupation</u>		<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
318	Transportation ticket and reservation agents	X		
319	Receptionists			X
323	Information clerks, n.e.c.			X
Records-processing occupations, except financial				
325	Classified-ad clerks			X
326	Correspondence clerks			X
327	Order clerks			X
328	Personnel clerks, except payroll and timekeeping	X		
329	Library clerks			X
335	File clerks			X
336	Records clerks	X		
Financial records processing occupations				
337	Bookkeepers, accounting, and auditing clerks	X		
338	Payroll and timekeeping clerks	X		
339	Billing clerks	X		
343	Cost and rate clerks	X		
344	Billing, posting, and calculating machine operators			X
Duplicating, mail and other office machine operators				
345	Duplicating machine operators			X
346	Mail preparing and paper handling machine operators			X
347	Office machine operators, n.e.c.			X
Communications equipment operators				
348	Telephone operators	X		
349	Telegraphers	X		
353	Communications equipment operators, n.e.c.			X
Mail and message-distributing occupations				
354	Postal clerks, except mail carriers	X		
355	Mail carriers, postal service			X
356	Mail clerks, except postal service			X
357	Messengers	X		
Material recording, scheduling, and distributing clerks				
359	Dispatchers	X		
363	Production coordinators	X		
364	Traffic, shipping, and receiving clerks	X		
365	Stock and inventory clerks	X		
366	Meter readers			X
368	Weighers, measurers, and checkers	X		
369	Samplers			X

<u>Census occupation</u>		<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
373	Expeditors	X		
374	Material recording, scheduling, and distributing clerks, n.e.c.	X		
Adjusters and investigators				
375	Insurance adjusters, examiners, and investigators			X
376	Investigators and adjusters, except insurance			X
377	Eligibility clerks, social welfare			X
378	Bill and account collectors			X
Miscellaneous administrative support occupations				
379	General office clerks	X		
383	Bank tellers			X
384	Proofreaders			X
385	Data-entry keyers	X		
386	Statistical clerks	X		
387	Teachers' aides			X
389	Administrative support occupations, n.e.c.	X		
SERVICE OCCUPATIONS				
Private Household Occupations				
403	Launderers and ironers			X
404	Cooks, private household			X
405	Housekeepers and butlers			X
406	Child-care workers, private household			X
407	Private household cleaners and servants			X
Protective Service Occupations				
Supervisors, protective service occupations				
413	Supervisors, firefighting and fire prevention occupations	X		
414	Supervisors, police and detectives	X	X	
415	Supervisors, guards	X		
Firefighting and fire prevention occupations				
416	Fire inspection and fire prevention occupations	X		
417	Firefighting occupations	X		
Police and detectives				
418	Police and detectives, public service	X	X	
423	Sheriffs, bailiffs, and other law enforcement officers	X	X	
424	Correctional institution officers	X		

<u>Census occupation</u>	<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
Guards			
425 Crossing guards			X
426 Guards and police, except public service	X		
427 Protective service occupations, n.e.c.			X
Service Occupations, Except Protective and Household			
Food preparation and service occupations			
433 Supervisors, food preparation and service occupations	X		
434 Bartenders			X
435 Waiters and waitresses			X
436 Cooks, except short order	X		
437 Short-order cooks			X
438 Food counter, fountain and related occupations			X
439 Kitchen workers, food preparation	X		
443 Waiters'/waitresses' assistants			X
444 Miscellaneous food preparation occupations			X
Health service occupations			
445 Dental assistants	X		
446 Health aides, except nursing	X		
447 Nursing aides, orderlies, and attendants	X		
Cleaning and building service occupations, except household			
448 Supervisors, cleaning and building service workers	X		
449 Maids and housemen			X
453 Janitors and cleaners			X
454 Elevator operators			X
455 Pest control occupations	X		
Personal service occupations			
456 Supervisors, personal service occupations			X
457 Barbers	X		
458 Hairdressers and cosmetologists			X
459 Attendants, amusement and recreation facilities			X
463 Guides			X
464 Ushers			X
465 Public transportation attendants	X		
466 Baggage porters and bellhops			X
467 Welfare service aides			X
468 Child care workers, except private household			X
469 Personal service occupations, n.e.c.			X

<u>Census occupation</u>		<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
FARMING, FORESTRY, AND FISHING OCCUPATIONS				
Farm Operators and Managers				
473	Farmers, except horticultural			X
474	Horticultural specialty farmers			X
475	Managers, farms, except horticultural			X
476	Managers, horticultural specialty farms			X
Other Agricultural and Related Occupations				
Farm occupations, except managerial				
477	Supervisors, farm workers			X
479	Farm workers			X
483	Marine life cultivation workers			X
484	Nursery workers			X
Related agricultural occupations				
485	Supervisors, related agricultural occupations			X
486	Groundskeepers and gardeners, except farm			X
487	Animal caretakers, except farm			X
488	Graders and sorters, agricultural products			X
489	Inspectors, agricultural products			X
Forestry and logging occupations				
494	Supervisors, forestry and logging workers			X
495	Forestry workers, except logging			X
496	Timber cutting and logging occupations			X
Fishers, hunters, and trappers				
497	Captains and other officers, fishing vessels			X
498	Fishers			X
499	Hunters and trappers			X
PRECISION PRODUCTION, CRAFT, AND REPAIR OCCUPATIONS				
Mechanics and Repairers				
503	Supervisors, mechanics and repairers	X		
Mechanics and repairers, except supervisors				
Vehicle and mobile equipment mechanics and repairers				
505	Automobile mechanics	X		
506	Automobile mechanic apprentices			X
507	Bus, truck, and stationary engine mechanics	X		
508	Aircraft engine mechanics	0 ¹		

1. These Census codes were matched by the procedure explained in the text.

Census occupation		Enlisted <u>match</u>	Officer <u>match</u>	No <u>match</u>
509	Small engine repairers	X		
514	Automobile body and related repairers	X		
515	Aircraft mechanics, except engine	X		
516	Heavy equipment mechanics	X		
517	Farm equipment mechanics			X
518	Industrial machinery repairers	X		
519	Machinery maintenance occupations	X		
Electrical and electronic equipment repairers				
523	Electronic repairers, communications and industrial equipment	X		
525	Data processing equipment repairers	X		
526	Household appliance and power tool repairers	X		
527	Telephone line installers and repairers	X		
529	Telephone installers and repairers	X		
533	Miscellaneous electrical and electronic equipment repairers	X		
534	Heating, air conditioning, and refrigeration mechanics	X		
Miscellaneous mechanics and repairers				
535	Camera, watch, and musical instrument repairers	X		
536	Locksmiths, and safe repairers	X		
538	Office machine repairers	X		
539	Mechanical controls and valve repairers	X		
543	Elevator installers and repairers	X		
544	Millwrights	X		
547	Specified mechanics and repairers, n.e.c.	X		
549	Not specified mechanics and repairers			X
Construction Trades				
Supervisors, construction occupations				
553	Supervisors, brickmasons, stonemasons, and tile setters	X		
554	Supervisors, carpenters and related workers	X		
555	Supervisors, electricians and power transmission installers	X		
556	Supervisors, painters, paperhangers, and plasterers	X		
557	Supervisors, plumbers, pipefitters, and steamfitters	X		
558	Supervisors, n.e.c.	X		
Construction trades, except supervisors				
563	Brickmasons and stonemasons	X		
564	Brickmason and stonemason apprentices			X
565	Tile setters, hard and soft			X
566	Carpet installers			X
567	Carpenters	X		
569	Carpet apprentices			X

<u>Census occupation</u>		<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
573	Drywall installers			X
575	Electricians	X		
576	Electrician apprentices			X
577	Electrical power installers and repairers	X		
579	Painters, construction and maintenance	X		
583	Paperhangers			X
584	Plasterers			X
585	Plumbers, pipefitters, and steamfitters	X		
587	Plumber, pipefitter, and steamfitter apprentices			X
588	Concrete and terrazzo finishers	X		
589	Glaziers			X
593	Insulation workers			X
594	Paving, surfacing, and tamping equipment operators	X		
595	Roofers			X
596	Sheetmetal duct installers			X
597	Structural metal workers	X		
598	Drillers, earth	X		
599	Construction trades, n.e.c.	X		
Extractive Occupations				
613	Supervisors, extractive occupations	X		
614	Drillers, oil well			X
615	Explosives workers	X		
616	Mining machine operators			X
617	Mining occupations, n.e.c.			X
Precision Production Occupations				
633	Supervisors, production occupations	X	X	
Precision metal-working occupations				
634	Tool and die makers			X
635	Tool and die maker apprentices			X
636	Precision assemblers, metal			X
637	Machinists	X		
639	Machinist apprentices			X
643	Boilermakers	X		
644	Precision grinders, fitters, and tool sharpeners	X		
645	Patternmakers and model makers, metal			X
646	Lay-out workers	X		
647	Precious stones and metals workers (jewelers)			X
649	Engravers, metal			X
653	Sheet metal workers	X		
654	Sheet metal worker apprentices			X
655	Miscellaneous precision metal workers	X		

<u>Census occupation</u>	<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
Precision woodworking occupations			
656 Patternmakers and model makers, wood			X
657 Cabinet makers and bench carpenters	X		
658 Furniture and wood finishers			X
659 Miscellaneous precision woodworkers			X
Precision textile, apparel, and furnishings machine workers			
666 Dressmakers	X		
667 Tailors			X
668 Upholsterers			X
669 Shoe repairers			X
673 Apparel and fabric patternmakers			X
674 Miscellaneous precision apparel and fabric workers			X
Precision workers, assorted materials			
675 Hand molders and shapers, except jewelers	X		
676 Patternmakers, lay-out workers, and cutters	X		
677 Optical goods workers	X		
678 Dental laboratory and medical appliance technicians	X		
679 Bookbinders			X
683 Electrical and electronic equipment assemblers			X
684 Miscellaneous precision workers, n.e.c.	X		
Precision food production occupations			
686 Butchers and meat cutters	X		
687 Bakers			X
688 Food batchmakers			X
Precision inspectors, testers, and related workers			
689 Inspectors, testers, and graders	X		
693 Adjusters and calibrators			X
Plant and system operators			
694 Water and sewage treatment plant operators	X		
695 Power plant operators	X		
696 Stationary engineers	X		
699 Miscellaneous plant and system operators	X		
OPERATORS, FABRICATORS, AND LABORERS			
Machine Operators, Assemblers, and Inspectors			
Machine operators and tenders, except precision			
Metal-working and plastic-working machine operators			
703 Lathe and turning machine set-up operators			X
704 Lathe and turning machine operators			X

<u>Census occupation</u>		<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
705	Milling and planing machine operators			X
706	Punching and stamping press machine operators			X
707	Rolling machine operators			X
708	Drilling and boring machine operators			X
709	Grinding, abreading, buffing, and polishing machine operators			X
713	Forging machine operators			X
714	Numerical control machine operators			X
715	Miscellaneous metal, plastic, stone, and glass working machine operators	X		
717	Fabricating machine operators, n.e.c.			X
Metal and plastic processing machine operators				
719	Molding and casting machine operators			X
723	Metal plating machine operators	X		
724	Heat treating equipment operators	X		
725	Miscellaneous metal and plastic processing machine operators			X
Woodworking machine operators				
726	Wood lathe, routing, and planing machine operators			X
727	Sawing machine operations	X		
728	Shaping and joining machine operators			X
729	Nailing and tacking machine operators			X
733	Miscellaneous woodworking machine operators			X
Printing machine operators				
734	Printing machine operators	X		
735	Photoengravers and lithographers	X		
736	Typesetters and compositors			X
737	Miscellaneous printing machine operators	X		
Textile, apparel, and furnishings machine operators				
738	Winding and twisting machine operators			X
739	Knitting, looping, taping, and weaving machine operators			X
743	Textile cutting machine operators			X
744	Textile sewing machine operators			X
745	Shoe machine operators			X
747	Pressing machine operators			X
748	Laundering and dry cleaning machine operators	X		
749	Miscellaneous textile machine operators			X
Machine operators, assorted materials				
753	Cementing and gluing machine operators			X
754	Packaging and filling machine operators	X		
755	Extruding and forming machine operators			X
756	Mixing and blending machine operators			X
757	Separating, filtering, and clarifying machine operators			X

<u>Census occupation</u>		<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
758	Compressing and compacting machine operators			X
759	Painting and paint spraying machine operators	X		
763	Roasting and basking machine operators, food			X
764	Washing, cleaning, and pickling machine operators			X
765	Folding machine operators			X
766	Furnace, kiln, and oven operators, except food			X
768	Crushing and grinding machine operators			X
769	Slicing and cutting machine operators			X
773	Motion picture projectionists	X		
774	Photographic process machine operators	X		
777	Miscellaneous machine operators, n.e.c.	X		
779	Machine operators, not specified			X
Fabricators, assemblers, and hand-working occupations				
783	Welders and cutters	X		
784	Solderers and brazers			X
785	Assemblers	X		
786	Hand cutting and trimming occupations			X
787	Hand molding, casting, and forming occupations			X
789	Hand painting, coating, and decorating occupations			X
793	Hand engraving and printing occupations			X
794	Hand grinding and polishing occupations			X
795	Miscellaneous hand-working occupations	X		
Production inspectors, testers, samplers, and weighers				
796	Production inspectors, checkers, and examiners	X		
797	Production testers	X		
798	Producing samplers and weighers			X
799	Graders and sorters, except agricultural			X
Transportation and Material Moving Occupations				
Motor vehicle operators				
803	Supervisors, motor vehicle operators	X		
804	Truck drivers, heavy	X		
805	Truck drivers, light	X		
806	Driver-sales workers			X
808	Bus drivers			X
809	Taxicab drivers and chauffers			X
813	Parking lot attendants			X
814	Motor transportation occupations, n.e.c.			X
Transportation occupations, except motor vehicles				
Rail transportation occupations				
823	Railroad conductors and yardmaster	X		
824	Locomotive operating occupations	X		

<u>Census occupation</u>		<u>Enlisted match</u>	<u>Officer match</u>	<u>No match</u>
825	Railroad brake, signal, and switch operators	X		
826	Rail vehicle operators, n.e.c.	X		
Water transportation occupations				
828	Ship captains and mates, except fishing boats	X	X	
829	Sailors and deckhands	X		
833	Marine engineers	X	X	
834	Bridge, lock, and lighthouse tenders			X
Material moving equipment operators				
843	Supervisors, material moving equipment operators	X		
844	Operating engineers	X		
845	Longshore equipment operators	X		
848	Hoist and winch operators	X		
849	Crane and tower operators	X		
853	Excavating and loading machine operators			X
855	Grader, dozer, and scraper operators			X
856	Industrial truck and tractor equipment operators	X		
859	Miscellaneous material moving equipment operators	X		
Handlers, Equipment Cleaners, Helpers, and Laborers				
863	Supervisors, handlers, equipment cleaners, and laborers, n.e.c.	X		
864	Helpers, mechanics and repairers			X
Helpers, construction and extractive occupations				
865	Helpers, construction trades			X
866	Helpers, surveyor			X
867	Helpers, extractive occupations			X
869	Construction laborers		X	
873	Production helpers			X
Freight, stock, and material handlers				
875	Garbage collectors			X
876	Stevedores	X		
877	Stock handlers and baggers			X
878	Machine feeders and offbearers			X
883	Freight, stock, and material handlers, n.e.c.	X		
885	Garage and service station related occupations			X
887	Vehicle washers and equipment cleaners	X		
888	Hand packers and packagers	X		
889	Laborers, except construction	X		

APPENDIX C

EXAMPLES OF OUTPUT FROM CNA NATIONAL MANPOWER INVENTORY MODEL

APPENDIX C

EXAMPLES OF OUTPUT FROM CNA NATIONAL MANPOWER INVENTORY MODEL

This appendix lists selected military occupations and reports corresponding civilian inventories. The reports are organized by service branch and community. For each military occupation, the service occupation code and the DoD occupational code are provided. The age and gender groups are as follows:

Age group 1: 16-19 years
2: 20-24 years
3: 25-29 years
4: 30-34 years
5: 35-39 years

Sex group 1: Males
2: Females

ARMY ENLISTED OCCUPATIONS

030 12B COMBAT ENGINEER¹

AGE GROUP	1	1.571E+05
AGE GROUP	2	2.327E+05
AGE GROUP	3	1.335E+05
AGE GROUP	4	8.604E+04
AGE GROUP	5	6.400E+04
SEX	1	6.734E+05
TOTAL		6.734E+05

704 44B METAL WORKER

AGE GROUP	1	1.541E+05
AGE GROUP	2	4.147E+05
AGE GROUP	3	3.478E+05
AGE GROUP	4	2.705E+05
AGE GROUP	5	2.017E+05
SEX	1	1.389E+06
AGE GROUP	1	7.760E+03
AGE GROUP	2	1.980E+04
AGE GROUP	3	1.636E+04
AGE GROUP	4	1.192E+04
AGE GROUP	5	9.680E+03
SEX	2	6.552E+04
TOTAL		1.454E+06

1. This occupation is restricted to males.

811 64C

MOTOR TRANSPORT OPERATOR

AGE GROUP	1	1.554E+05
AGE GROUP	2	4.824E+05
AGE GROUP	3	5.477E+05
AGE GROUP	4	5.301E+05
AGE GROUP	5	4.807E+05
SEX	1	2.196E+06
AGE GROUP	1	1.982E+04
AGE GROUP	2	5.890E+04
AGE GROUP	3	5.860E+04
AGE GROUP	4	5.530E+04
AGE GROUP	5	5.060E+04
SEX	2	2.432E+05
TOTAL		2.439E+06

300 91C

PRACTICAL NURSE

AGE GROUP	1	2.600E+02
AGE GROUP	2	2.100E+03
AGE GROUP	3	3.360E+03
AGE GROUP	4	2.640E+03
AGE GROUP	5	1.680E+03
SEX	1	1.004E+04
AGE GROUP	1	4.540E+03
AGE GROUP	2	6.454E+04
AGE GROUP	3	8.416E+04
AGE GROUP	4	6.748E+04
AGE GROUP	5	4.978E+04
SEX	2	2.705E+05
TOTAL		2.805E+05

512 71D

LEGAL CLERK

AGE GROUP	1	7.000E+02
AGE GROUP	2	5.900E+03
AGE GROUP	3	6.340E+03
AGE GROUP	4	3.460E+03
AGE GROUP	5	1.820E+03
SEX	1	1.822E+04
AGE GROUP	1	1.420E+03
AGE GROUP	2	1.270E+04
AGE GROUP	3	1.438E+04
AGE GROUP	4	9.500E+03
AGE GROUP	5	5.720E+03
SEX	2	4.372E+04
TOTAL		6.194E+04

ARMY COMMISSIONED OFFICERS

7H 31A LAW ENFORCEMENT OFFICER

AGE GROUP	1	3.800E+02
AGE GROUP	2	6.680E+03
AGE GROUP	3	1.380E+04
AGE GROUP	4	2.068E+04
AGE GROUP	5	1.974E+04
SEX	1	6.128E+04
AGE GROUP	1	2.200E+02
AGE GROUP	2	1.620E+03
AGE GROUP	3	2.040E+03
AGE GROUP	4	2.160E+03
AGE GROUP	5	1.620E+03
SEX	2	7.660E+03
TOTAL		6.894E+04

5G 56A COMMAND AND UNIT CHAPLAIN

AGE GROUP	1	6.000E+02
AGE GROUP	2	8.740E+03
AGE GROUP	3	2.768E+04
AGE GROUP	4	3.514E+04
AGE GROUP	5	3.060E+04
SEX	1	1.028E+05
AGE GROUP	1	6.000E+01
AGE GROUP	2	1.300E+03
AGE GROUP	3	2.740E+03
AGE GROUP	4	2.380E+03
AGE GROUP	5	1.900E+03
SEX	2	8.380E+03
TOTAL		1.111E+05

6A 60E

GENERAL MEDICINE OFFICER

AGE GROUP	1	1.600E+02
AGE GROUP	2	2.540E+03
AGE GROUP	3	4.286E+04
AGE GROUP	4	6.510E+04
AGE GROUP	5	5.552E+04
SEX	1	1.662E+05
AGE GROUP	1	1.200E+02
AGE GROUP	2	3.420E+03
AGE GROUP	3	1.364E+04
AGE GROUP	4	1.380E+04
AGE GROUP	5	9.480E+03
SEX	2	4.046E+04
TOTAL		2.066E+05

6C 63A

DENTAL OFFICER

AGE GROUP	1	1.000E+02
AGE GROUP	2	6.400E+02
AGE GROUP	3	1.338E+04
AGE GROUP	4	1.938E+04
AGE GROUP	5	1.734E+04
SEX	1	5.084E+04
AGE GROUP	1	3.200E+02
AGE GROUP	2	1.740E+03
AGE GROUP	3	2.720E+03
AGE GROUP	4	1.460E+03
AGE GROUP	5	8.200E+02
SEX	2	7.060E+03
TOTAL		5.790E+04

ARMY WARRANT OFFICER

8B 761A GENERAL SUPPLY TECHNICIAN

AGE GROUP	1	2.468E+04
AGE GROUP	2	1.228E+05
AGE GROUP	3	1.781E+05
AGE GROUP	4	1.836E+05
AGE GROUP	5	1.561E+05
SEX	1	6.654E+05
AGE GROUP	1	1.762E+04
AGE GROUP	2	7.674E+04
AGE GROUP	3	7.500E+04
AGE GROUP	4	6.544E+04
AGE GROUP	5	5.680E+04
SEX	2	2.916E+05
TOTAL		9.570E+05

NAVY ENLISTED

222 AC

AIR TRAFFIC CONTROLLER, CHIEF TO
MASTER CHIEF

AGE GROUP	1	2.800E+02
AGE GROUP	2	1.920E+03
AGE GROUP	3	4.540E+03
AGE GROUP	4	7.660E+03
AGE GROUP	5	5.080E+03
SEX	1	1.948E+04
AGE GROUP	1	2.200E+02
AGE GROUP	2	1.240E+03
AGE GROUP	3	1.840E+03
AGE GROUP	4	1.360E+03
AGE GROUP	5	6.600E+02
SEX	2	5.320E+03
TOTAL		2.480E+04

601 AD

AVIATION MACHINIST'S MATE, THIRD
TO SECOND CLASS

AGE GROUP	1	2.400E+03
AGE GROUP	2	1.218E+04
AGE GROUP	3	1.356E+04
AGE GROUP	4	1.534E+04
AGE GROUP	5	1.326E+04
SEX	1	5.674E+04
AGE GROUP	1	2.000E+02
AGE GROUP	2	5.200E+02
AGE GROUP	3	6.800E+02
AGE GROUP	4	4.800E+02
AGE GROUP	5	3.800E+02
SEX	2	2.260E+03
TOTAL		5.900E+04

100 AT

AVIATION ELECTRONICS TECHNICIAN,
THIRD TO FIRST CLASS

AGE GROUP	1	1.250E+04
AGE GROUP	2	6.398E+04
AGE GROUP	3	6.986E+04
AGE GROUP	4	5.754E+04
AGE GROUP	5	4.170E+04
SEX	1	2.456E+05
AGE GROUP	1	1.940E+03
AGE GROUP	2	9.060E+03
AGE GROUP	3	8.020E+03
AGE GROUP	4	5.800E+03
AGE GROUP	5	4.160E+03
SEX	2	2.898E+04
TOTAL		2.746E+05

100 AT

AVIATION ELECTRONICS TECHNICIAN,
CHIEF

AGE GROUP	1	9.400E+02
AGE GROUP	2	8.460E+03
AGE GROUP	3	1.610E+04
AGE GROUP	4	2.108E+04
AGE GROUP	5	1.964E+04
SEX	1	6.622E+04
AGE GROUP	1	1.800E+02
AGE GROUP	2	8.400E+02
AGE GROUP	3	8.200E+02
AGE GROUP	4	7.400E+02
AGE GROUP	5	7.600E+02
SEX	2	3.340E+03
TOTAL		6.956E+04

710 BU

BUILDER, THIRD CLASS TO SECOND
CLASS

AGE GROUP	1	1.609E+05
AGE GROUP	2	3.944E+05
AGE GROUP	3	3.513E+05
AGE GROUP	4	2.500E+05
AGE GROUP	5	1.763E+05
SEX	1	1.333E+06
AGE GROUP	1	1.008E+04
AGE GROUP	2	1.528E+04
AGE GROUP	3	1.108E+04
AGE GROUP	4	8.040E+03
AGE GROUP	5	6.380E+03
SEX	2	5.086E+04
TOTAL		1.384E+06

500 PN

PERSONNELMAN, FIRST CLASS TO
CHIEF

AGE GROUP	1	3.700E+03
AGE GROUP	2	1.992E+04
AGE GROUP	3	3.148E+04
AGE GROUP	4	3.960E+04
AGE GROUP	5	3.444E+04
SEX	1	1.291E+05
AGE GROUP	1	5.680E+03
AGE GROUP	2	3.880E+04
AGE GROUP	3	5.878E+04
AGE GROUP	4	5.838E+04
AGE GROUP	5	4.384E+04
SEX	2	2.055E+05
TOTAL		3.346E+05

201 RM

RADIOMAN, THIRD CLASS TO FIRST
CLASS

AGE GROUP	1	2.340E+03
AGE GROUP	2	8.640E+03
AGE GROUP	3	8.120E+03
AGE GROUP	4	5.300E+03
AGE GROUP	5	3.840E+03
SEX	1	2.824E+04
AGE GROUP	1	2.440E+03
AGE GROUP	2	9.480E+03
AGE GROUP	3	7.700E+03
AGE GROUP	4	4.940E+03
AGE GROUP	5	3.620E+03
SEX	2	2.818E+04
TOTAL		5.642E+04

NAVY OFFICERS

4B 5917

ELECTRONIC EQUIPMENT RESEARCH OFFICER

AGE GROUP	1	1.220E+03
AGE GROUP	2	2.808E+04
AGE GROUP	3	4.626E+04
AGE GROUP	4	5.296E+04
AGE GROUP	5	4.264E+04
SEX	1	1.712E+05
AGE GROUP	1	2.600E+02
AGE GROUP	2	3.580E+03
AGE GROUP	3	4.200E+03
AGE GROUP	4	3.000E+03
AGE GROUP	5	1.580E+03
SEX	2	1.262E+04
TOTAL		1.838E+05

4D 8190

AIRCRAFT INTERMEDIATE MAINTENANCE OFFICER, GENERAL

AGE GROUP	1	5.728E+04
AGE GROUP	2	2.615E+05
AGE GROUP	3	4.124E+05
AGE GROUP	4	5.286E+05
AGE GROUP	5	5.105E+05
SEX	1	1.770E+06
AGE GROUP	1	4.328E+04
AGE GROUP	2	1.785E+05
AGE GROUP	3	2.156E+05
AGE GROUP	4	2.118E+05
AGE GROUP	5	1.779E+05
SEX	2	8.270E+05
TOTAL		2.597E+06

6E 0944

STAFF NURSE

AGE GROUP	1	5.400E+02
AGE GROUP	2	6.080E+03
AGE GROUP	3	1.424E+04
AGE GROUP	4	1.346E+04
AGE GROUP	5	6.220E+03
SEX	1	4.054E+04
AGE GROUP	1	3.540E+03
AGE GROUP	2	1.619E+05
AGE GROUP	3	2.662E+05
AGE GROUP	4	2.067E+05
AGE GROUP	5	1.607E+05
SEX	2	7.990E+05
TOTAL		8.396E+05

7E 9735

COMPUTER SYSTEMS ANALYST

AGE GROUP	1	5.400E+02
AGE GROUP	2	1.152E+04
AGE GROUP	3	2.826E+04
AGE GROUP	4	3.620E+04
AGE GROUP	5	3.014E+04
SEX	1	1.067E+05
AGE GROUP	1	4.400E+02
AGE GROUP	2	6.500E+03
AGE GROUP	3	1.336E+04
AGE GROUP	4	1.168E+04
AGE GROUP	5	5.740E+03
SEX	2	3.772E+04
TOTAL		1.444E+05

AIR FORCE ENLISTED

150 30554	ELECTRONIC COMPUTER AND SWITCHING SYSTEMS SPECIALIST	
AGE GROUP	1	1.250E+04
AGE GROUP	2	6.398E+04
AGE GROUP	3	6.986E+04
AGE GROUP	4	5.754E+04
AGE GROUP	5	4.170E+04
SEX	1	2.456E+05
AGE GROUP	1	1.940E+03
AGE GROUP	2	9.060E+03
AGE GROUP	3	8.020E+03
AGE GROUP	4	5.800E+03
AGE GROUP	5	4.160E+03
SEX	2	2.898E+04
TOTAL		2.746E+05

150 30574	ELECTRONIC COMPUTER AND SWITCHING SYSTEMS TECHNICIAN	
AGE GROUP	1	9.400E+02
AGE GROUP	2	8.460E+03
AGE GROUP	3	1.610E+04
AGE GROUP	4	2.108E+04
AGE GROUP	5	1.964E+04
SEX	1	6.622E+04
AGE GROUP	1	1.800E+02
AGE GROUP	2	8.400E+02
AGE GROUP	3	8.200E+02
AGE GROUP	4	7.400E+02
AGE GROUP	5	7.600E+02
SEX	2	3.340E+03
TOTAL		6.956E+04

201 29353 GROUND RADIO OPERATOR

AGE GROUP	1	2.340E+03
AGE GROUP	2	8.640E+03
AGE GROUP	3	8.120E+03
AGE GROUP	4	5.300E+03
AGE GROUP	5	3.840E+03
SEX	1	2.824E+04
AGE GROUP	1	2.440E+03
AGE GROUP	2	9.480E+03
AGE GROUP	3	7.700E+03
AGE GROUP	4	4.940E+03
AGE GROUP	5	3.620E+03
SEX	2	2.818E+04
TOTAL		5.642E+04

201 29373 GROUND RADIO OPERATIONS
SUPERVISOR

AGE GROUP	1	2.340E+03
AGE GROUP	2	9.260E+03
AGE GROUP	3	1.096E+04
AGE GROUP	4	1.182E+04
AGE GROUP	5	9.960E+03
SEX	1	4.434E+04
AGE GROUP	1	2.320E+03
AGE GROUP	2	9.780E+03
AGE GROUP	3	1.070E+04
AGE GROUP	4	8.800E+03
AGE GROUP	5	5.960E+03
SEX	2	3.756E+04
TOTAL		8.190E+04

553 60251 FREIGHT TRAFFIC SPECIALIST

AGE GROUP	1	4.164E+04
AGE GROUP	2	9.228E+04
AGE GROUP	3	6.198E+04
AGE GROUP	4	4.368E+04
AGE GROUP	5	3.090E+04
SEX	1	2.705E+05
AGE GROUP	1	9.960E+03
AGE GROUP	2	2.590E+04
AGE GROUP	3	1.928E+04
AGE GROUP	4	1.790E+04
AGE GROUP	5	1.350E+04
SEX	2	8.654E+04
TOTAL		3.570E+05

662 54252 ELECTRICAL POWER PRODUCTION
SPECIALIST

AGE GROUP	1	1.772E+04
AGE GROUP	2	7.248E+04
AGE GROUP	3	8.462E+04
AGE GROUP	4	7.994E+04
AGE GROUP	5	6.838E+04
SEX	1	3.231E+05
AGE GROUP	1	8.600E+02
AGE GROUP	2	3.820E+03
AGE GROUP	3	3.560E+03
AGE GROUP	4	2.940E+03
AGE GROUP	5	2.880E+03
SEX	2	1.406E+04
TOTAL		3.372E+05

662 54272 ELECTRICAL POWER PRODUCTION
TECHNICIAN

AGE GROUP	1	1.650E+04
AGE GROUP	2	1.155E+05
AGE GROUP	3	1.981E+05
AGE GROUP	4	2.330E+05
AGE GROUP	5	2.282E+05
SEX	1	7.913E+05
AGE GROUP	1	7.080E+03
AGE GROUP	2	3.062E+04
AGE GROUP	3	3.832E+04
AGE GROUP	4	3.860E+04
AGE GROUP	5	3.766E+04
SEX	2	1.523E+05
TOTAL		9.436E+05

AIR FORCE OFFICERS

4A 5516

CIVIL ENGINEERING STAFF OFFICER

AGE GROUP	1	6.600E+02
AGE GROUP	2	1.832E+04
AGE GROUP	3	3.388E+04
AGE GROUP	4	3.832E+04
AGE GROUP	5	3.036E+04
SEX	1	1.215E+05
AGE GROUP	1	1.600E+02
AGE GROUP	2	2.820E+03
AGE GROUP	3	2.580E+03
AGE GROUP	4	1.740E+03
AGE GROUP	5	9.000E+02
SEX	2	8.200E+03
TOTAL		1.297E+05

6A 9346

FAMILY PHYSICIAN

AGE GROUP	1	1.600E+02
AGE GROUP	2	2.540E+03
AGE GROUP	3	4.286E+04
AGE GROUP	4	6.510E+04
AGE GROUP	5	5.552E+04
SEX	1	1.662E+05
AGE GROUP	1	1.200E+02
AGE GROUP	2	3.420E+03
AGE GROUP	3	1.364E+04
AGE GROUP	4	1.380E+04
AGE GROUP	5	9.480E+03
SEX	2	4.046E+04
TOTAL		2.066E+05

2B 1045

PILOT, TRANSPORT

AGE GROUP	1	1.800E+02
AGE GROUP	2	3.400E+03
AGE GROUP	3	7.640E+03
AGE GROUP	4	1.444E+04
AGE GROUP	5	1.348E+04
SEX	1	3.914E+04
AGE GROUP	1	6.000E+01
AGE GROUP	2	2.000E+02
AGE GROUP	3	2.400E+02
AGE GROUP	4	2.600E+02
AGE GROUP	5	2.000E+02
SEX	2	9.600E+02
TOTAL		4.010E+04

4C 3016

COMMUNICATIONS-ELECTRONICS
SYSTEMS STAFF OFFICER

AGE GROUP	1	5.728E+04
AGE GROUP	2	2.615E+05
AGE GROUP	3	4.124E+05
AGE GROUP	4	5.286E+05
AGE GROUP	5	5.105E+05
SEX	1	1.770E+06
AGE GROUP	1	4.328E+04
AGE GROUP	2	1.785E+05
AGE GROUP	3	2.156E+05
AGE GROUP	4	2.118E+05
AGE GROUP	5	1.779E+05
SEX	2	8.270E+05
TOTAL		2.597E+06

2D 1535

NAVIGATOR, GENERAL

AGE GROUP	1	1.800E+02
AGE GROUP	2	3.400E+03
AGE GROUP	3	7.640E+03
AGE GROUP	4	1.444E+04
AGE GROUP	5	1.348E+04
SEX	1	3.914E+04
AGE GROUP	1	6.000E+01
AGE GROUP	2	2.000E+02
AGE GROUP	3	2.400E+02
AGE GROUP	4	2.600E+02
AGE GROUP	5	2.000E+02
SEX	2	9.600E+02
TOTAL		4.010E+04

MARINE CORPS ENLISTED

400 4641 PHOTOGRAPHER

AGE GROUP	1	3.560E+03
AGE GROUP	2	1.136E+04
AGE GROUP	3	1.390E+04
AGE GROUP	4	1.194E+04
AGE GROUP	5	8.160E+03
SEX	1	4.892E+04
AGE GROUP	1	3.300E+03
AGE GROUP	2	6.340E+03
AGE GROUP	3	5.400E+03
AGE GROUP	4	4.100E+03
AGE GROUP	5	2.500E+03
SEX	2	2.164E+04
TOTAL		7.056E+04

510 0151 ADMINISTRATIVE CLERK

AGE GROUP	1	4.842E+04
AGE GROUP	2	7.372E+04
AGE GROUP	3	4.220E+04
AGE GROUP	4	3.126E+04
AGE GROUP	5	2.052E+04
SEX	1	2.161E+05
AGE GROUP	1	1.963E+05
AGE GROUP	2	3.112E+05
AGE GROUP	3	2.041E+05
AGE GROUP	4	1.618E+05
AGE GROUP	5	1.311E+05
SEX	2	1.005E+06
TOTAL		1.221E+06

531 4034

COMPUTER OPERATOR

AGE GROUP	1	1.320E+04
AGE GROUP	2	5.162E+04
AGE GROUP	3	4.730E+04
AGE GROUP	4	3.886E+04
AGE GROUP	5	2.692E+04
SEX	1	1.779E+05
AGE GROUP	1	4.616E+04
AGE GROUP	2	1.658E+05
AGE GROUP	3	1.355E+05
AGE GROUP	4	1.073E+05
AGE GROUP	5	6.634E+04
SEX	2	5.210E+05
TOTAL		6.989E+05

MARINE CORPS OFFICERS

4C 2502 COMMUNICATION OFFICER (I, III)

AGE GROUP	1	1.140E+03
AGE GROUP	2	6.080E+03
AGE GROUP	3	1.576E+04
AGE GROUP	4	2.670E+04
AGE GROUP	5	2.490E+04
SEX	1	7.458E+04
AGE GROUP	1	1.240E+03
AGE GROUP	2	6.760E+03
AGE GROUP	3	1.344E+04
AGE GROUP	4	1.568E+04
AGE GROUP	5	1.314E+04
SEX	2	5.026E+04
TOTAL		1.248E+05

2E 1302 ENGINEER OFFICER (I)

AGE GROUP	1	5.728E+04
AGE GROUP	2	2.615E+05
AGE GROUP	3	4.124E+05
AGE GROUP	4	5.286E+05
AGE GROUP	5	5.105E+05
SEX	1	1.770E+06
AGE GROUP	1	4.328E+04
AGE GROUP	2	1.785E+05
AGE GROUP	3	2.156E+05
AGE GROUP	4	2.118E+05
AGE GROUP	5	1.779E+05
SEX	2	8.270E+05
TOTAL		2.597E+06

7H 5803

MILITARY POLICE OFFICER (I)

AGE GROUP	1	3.000E+02
AGE GROUP	2	5.960E+03
AGE GROUP	3	1.086E+04
AGE GROUP	4	1.240E+04
AGE GROUP	5	9.700E+03
SEX	1	3.922E+04
AGE GROUP	1	1.600E+02
AGE GROUP	2	1.520E+03
AGE GROUP	3	1.840E+03
AGE GROUP	4	1.780E+03
AGE GROUP	5	1.340E+03
SEX	2	6.640E+03
TOTAL		4.586E+04

APPENDIX D

EXAMPLES OF THE COMPUTER-GENERATED ALLOCATION MODULE REPORT

APPENDIX D

EXAMPLES OF THE COMPUTER-GENERATED ALLOCATION MODULE REPORT

This appendix reproduces every fortieth record from the allocation procedure described in the main text and summarized in table 10. The computer file is sorted by community (1 = Enlisted, 2 = Officer), pay grade ratio (civilian supply/military active strength), branch (1 = Army, 2 = Navy, 3 = Air Force, 4 = Marines), and the service occupational code. The order of the output is as follows: ratio, active duty strength, branch, community, pay grade, 3-digit DoD occupational code, and service occupational code. All fields are separated by one or two spaces; the last field contains the service occupational code. (Since each service has its own occupational coding scheme, which varies in length, there are often blank spaces in the last field.)

1.29E+00	2.4000000E+01	'4	2	5	2A	7511	'
1.27E+01	1.5000000E+01	'1	2	5	6C	63M	'
2.13E+01	7.6000000E+01	'1	2	5	6A	60W	'
2.13E+01	3.0000000E+00	'2	2	5	6A	0224	'
2.65E+01	2.0000000E+00	'1	2	5	5E	68T	'
4.19E+01	4.1000000E+01	'1	2	5	7M	67A	'
4.19E+01	1.0100000E+02	'3	2	5	2G	2255	'
4.63E+01	3.0000000E+00	'1	2	5	5A	52	'
1.17E+02	1.7000000E+01	'1	2	5	6F	66C	'
1.87E+02	2.0000000E+00	'2	2	5	5J	2085	'
1.33E+03	3.0000000E+00	'1	2	5	5C	68D	'
1.27E+01	1.8000000E+01	'2	2	6	6C	0345	'
2.13E+01	5.9000000E+01	'1	2	6	6A	61F	'
2.13E+01	5.0000000E+00	'2	2	6	6A	0264	'
3.50E+01	2.2000000E+01	'3	2	6	3C	8216	'
4.19E+01	6.0900000E+02	'3	2	6	2G	0036	'
6.81E+01	5.6000000E+01	'3	2	6	4A	5516	'
1.19E+02	1.6000000E+01	'3	2	6	7C	7416	'
1.27E+03	1.0000000E+00	'2	2	6	4N	2035	'

U223418

02 053301.00